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Engineering Assessment Report--Hazardous
Waste Cofiring in Industrial Boilers
Volume 2. Data Supplement

Acurex Corp., Mountain View, CA

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HAZARDOUS WASTE COFIRING IN INDUSTRIAL BOILERS

VOLUME II
DATA SUPPLEMENT

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ABSTRACT

This report documents results of 42 hazardous waste combustion tests performed on 11 full-scale industrial boilers. The report discusses the boiler operating conditions, measured organic and other gaseous emissions, and the achieved destruction efficiency of principal organic hazardous constituents (POHC's) present in the waste. The report is divided in two volumes. Volume I presents a summary of all test data, discusses conclusions, and highlights trends in POHC destruction and other byproduct emissions with respect to boiler operation and POHC type. Volume II is a compendium of boiler-specific test data summarized to provide readers with sufficient details to perform their own analyses. Major volatile POHC's investigated were carbon tetrachloride, chlorobenzene, trichloroethylene, and toluene. The destruction efficiency of 14 other volatile and semi-volatile hazardous organics is also reported. In general, industrial boilers tested achieved greater than 99.99 percent POHC destruction efficiency under conditions investigated. Although not clearly evident, the collected data point out lower destruction efficiencies with transient or off-specification burner and feedrate conditions. These conditions were at times manifested by increases in combustible emissions or burner flame instability. Lower limits of measured destruction efficiencies were generally found to increase with furnace waterwall heat release rate (kW/m^2) and measured NO_x emission, possibly indicating dependence of POHC destruction on the furnace thermal environment. Emissions of identifiable products of incomplete combustion (PIC's) were generally one to two orders of magnitude greater than POHC breakthrough emissions. Lower PIC emissions accompanied greater POHC destruction efficiencies. These and other trends are highlighted to point out areas requiring further research.

This report was submitted in partial fulfillment of Contract No. 68-02-3188 by Acurex Corporation under the sponsorship of the U.S. Environmental Protection Agency. This report covers a period from 1981 to 1984, and work was completed as of June 1984.

FOREWORD

When energy and material resources are extracted, processed, converted, and used, the related pollutional impacts on our environment and even on our health often require that new and increasingly more efficient pollution control methods be used. The Industrial Environmental Research Laboratory-Cincinnati (IERL-Ci) assists in developing and demonstrating new and improved methodologies that will meet these needs both efficiently and economically.

In 1981 the Office of Solid Waste, under RCRA, developed regulations for the incineration of hazardous waste. Industrial boilers are exempt from these regulations. In response to environmental concerns regarding this practice, the Agency has undertaken a multidisciplinary research program to determine the operating practices and destruction efficiency of boilers burning hazardous wastes as information necessary to regulation development and the Regulatory Impact Analysis (RIA) required under Executive Order 12291. One important area of this research program is the field testing of full-scale industrial boilers burning hazardous waste for disposal and energy recovery. Associated research activities include fundamental and pilot-scale waste destruction studies and the evaluation of sampling and analytical methods for particular wastes. This report documents the results of the field test program to characterize destruction efficiencies of representative industrial boilers burning hazardous wastes under typical industrial operating practices. The report is in two volumes. Volume I provides the technical results for the entire field test program. Volume II contains the data obtained at each of the field tests.

Requests for further information regarding combustion of hazardous wastes in high temperature industrial processes should be directed to the Energy Pollution Control Division, IERL, Cincinnati.

David G. Stephan
Director
Industrial Environmental Research Laboratory
Cincinnati

CONTENTS

	Acknowledgement	iii
	Abstract	iv
	Foreword	v
1	Introduction	1
2	Sampling and Analysis Protocols	3
	2.1 Boiler schematics, site schematics, and sampling and analytical test matrices	4
	2.2 Sampling protocols	36
	2.2.1 Continuous monitoring system	36
	2.2.2 Modified EPA Method 5	40
	2.2.3 Tenax trains and VOST	42
	2.2.4 Other sampling systems	47
	2.3 Analysis protocols	50
	2.3.1 Modified EPA Method 5 (semivolatile organics)	50
	2.3.2 VOST analysis (volatile organics)	55
3	Error Analysis	64
4	Summary of Sampling Data	70
	4.1 Site A	71
	4.2 Site B	73
	4.3 Site C	76
	4.4 Site D	79
	4.5 Site E	85
	4.6 Site F	99
	4.7 Site G	102
	4.8 Site H	108
	4.9 Site I	110
	4.10 Site J	113
	4.11 Site K	117
5	Summary of Analytical Emission Data	121
	5.1 Site A	122
	5.2 Site B	131

CONTENTS (Concluded)

5.3	Site C		139
5.4	Site D		149
5.5	Site E		166
5.6	Site F		192
5.7	Site G		213
5.8	Site H		236
5.9	Site I		239
5.10	Site J		246
5.11	Site K		261
	References		273

SECTION 1

INTRODUCTION

Early in 1982, the Incineration Research Branch of the Industrial Environmental Research Laboratory of EPA Cincinnati sponsored several emission test programs to measure destruction efficiencies of hazardous organic compounds cofired in full-scale industrial boilers. A total of 11 test sites were included in these emission measurement programs. Test descriptions and emission results have been documented in separate reports available through the EPA (References 1 through 11). As in Volume I of this report, these test sites are referred to in alphabetical order as site A through site K.

The purpose of this data supplement is to document data and information from each test program in greater detail than was possible in Volume I (Technical Results) of this Engineering Assessment Report (EAR). The primary intent of this data supplement volume is to provide sufficient detail for researchers to perform their own analysis of the data obtained. Readers are referred to the technical volume for EAR objectives, summary of boiler operation, waste fuels and emission results, interpretation, and conclusion.

The format of this data supplement has been arranged as follows:

- Section 2: Sampling and Analytical Protocols -- For each test site (A through K), schematics of test site boiler, feed systems, and sampling locations are provided. Discussion of site-specific test matrix, sampling, and analytical protocols used. This section highlights variations in protocols used among test sites and general interpretations of the impact these variations have on comparative status of emission results.
- Section 3: Error Analyses -- This section provides a quantitative estimate of the uncertainties in the sampling and analytical results and the overall impact of these uncertainties on the emissions and organic compound destruction efficiency results
- Section 4: Summary of Sampling Data -- Site-specific summary tables of boilers operation for each test are provided in this section. Tables summarize the complete data package on boiler operation, fuel flows, and sampling data. Summary tables were obtained directly from individual test reports.

- Section 5: Summary of Analytical and Emission Data -- This section incorporates the analytical data package from each test site. The data packages consist primarily of tabulated emission data presented in the individual test reports.

SECTION 2

SAMPLING AND ANALYTICAL PROTOCOLS

2.1 BOILER, SITE SCHEMATICS AND SAMPLING AND ANALYTICAL TEST MATRICES

2.2 SAMPLING PROTOCOLS

2.2.1 Continuous Monitors

2.2.2 Modified EPA Method 5

2.2.3 Tenax Trains and VOST

2.2.4 Other Sampling Systems

2.2.4.1 Modified EPA Method 6

2.2.4.2 C₁ - C₆ Sampling and Analysis

2.3 ANALYSIS PROTOCOLS

2.3.1 Modified EPA Method 5 (Semivolatile Organics)

2.3.2 VOST (Volatile Organics)

2.1 BOILER SCHEMATICS, SITE SCHEMATICS, AND SAMPLING AND ANALYTICAL TEST
MATRICES

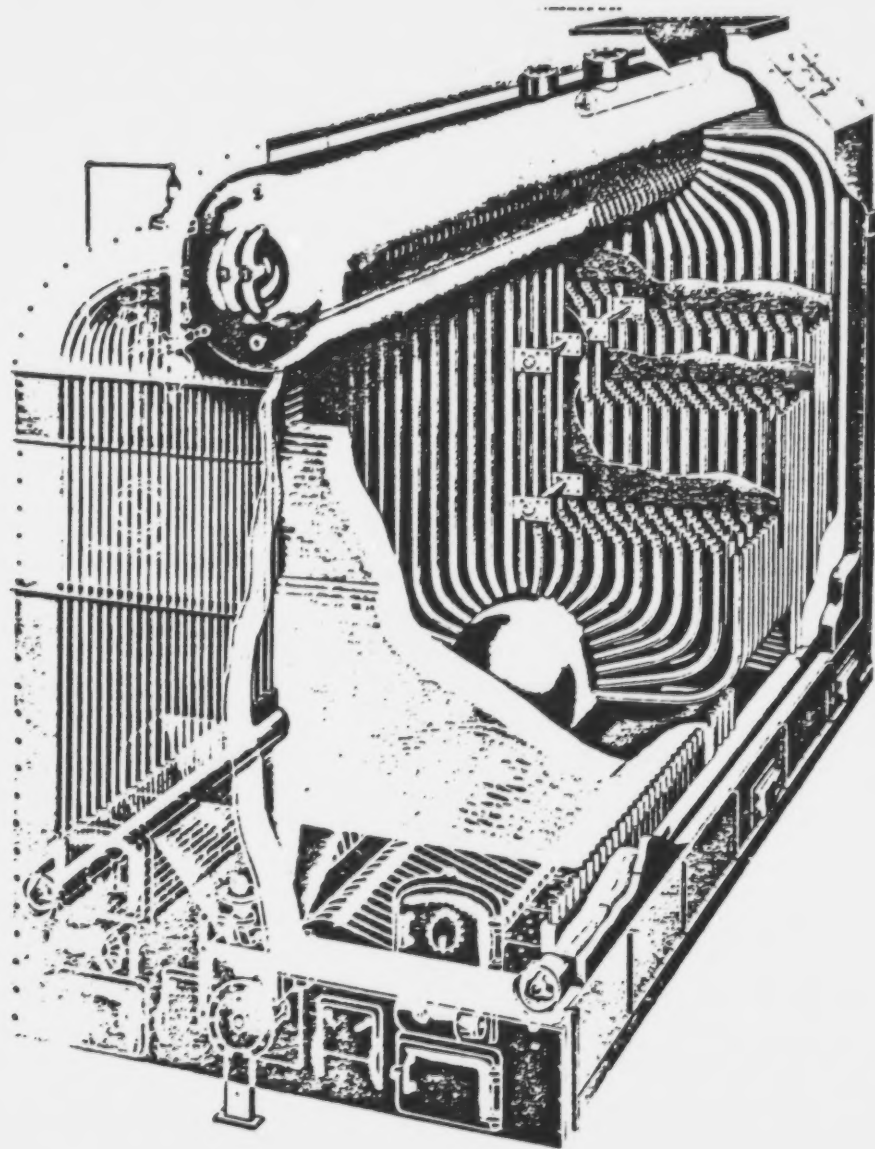


Figure 1. Keeler type CP steam generator -- site A.

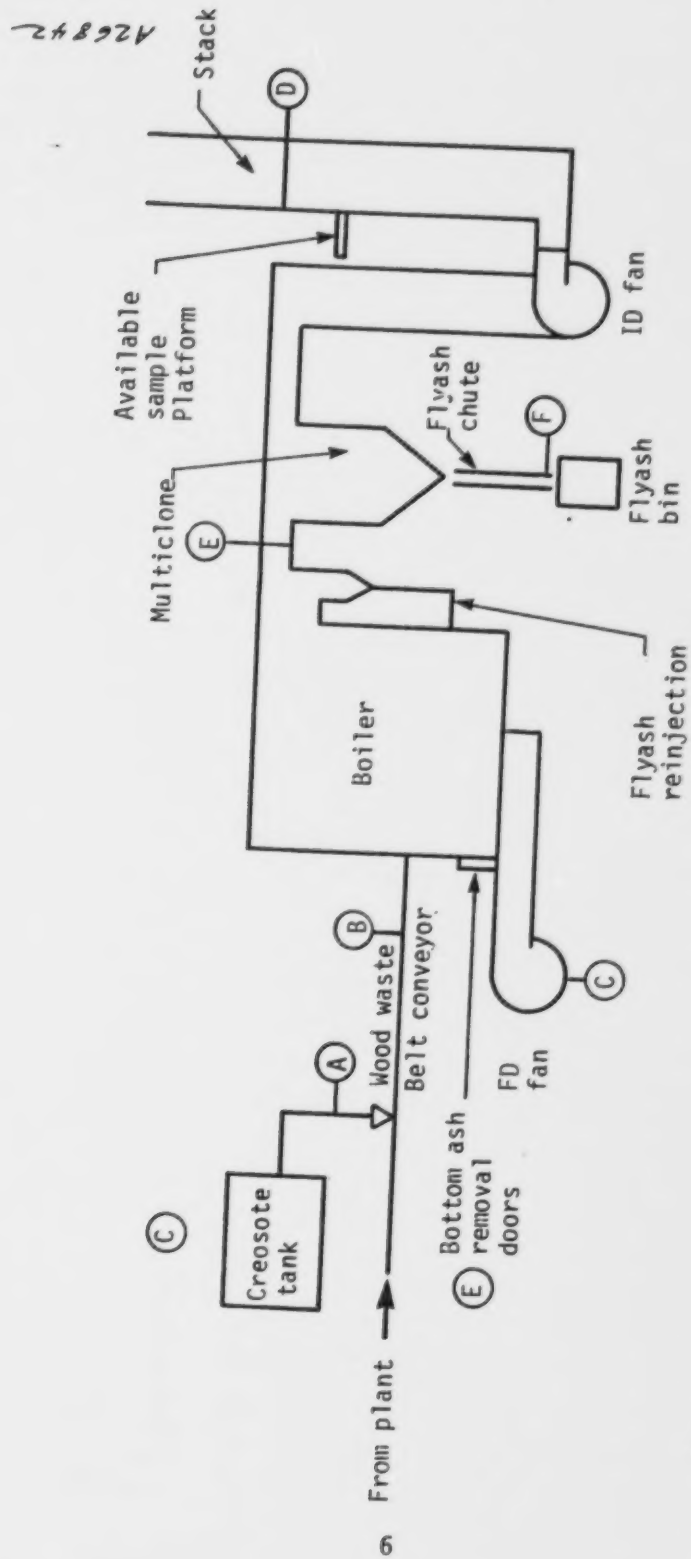


Figure 2. Site layout -- site A.

TABLE 1. SAMPLING AND ANALYSIS MATRIX -- SITE A

Location	Type of sample/equipment		Analyses
A -- Creosote tank spout	Creosote --	Composite sample	Semivolatile and nonvolatile organics by GC/MS
B -- Wood waste belt conveyor	Wood and mixed fuel	-- Composite sample	Ultimate analysis: C, H, N, O, H ₂ O, and heating value
C -- Stack	Flue gas	-- Tenax train	Ultimate analysis: C, H, N, O, H ₂ O, and heating value
	Flue gas	-- Modified EPA Method 5 with XAD-2 sorbent	Volatile organics
	Flue gas	-- Continuous monitors	Semivolatile and nonvolatile organics by GC/MS
D -- Bottom ash hopper	Bottom ash	-- Composite sample	O ₂ , CO, CO ₂ , NO/NO _x , and TUHC
E -- Flyash hopper	Flyash	-- Composite sample	Semivolatile and nonvolatile organics by GC/MS
			Semivolatile and nonvolatile organics by GC/MS

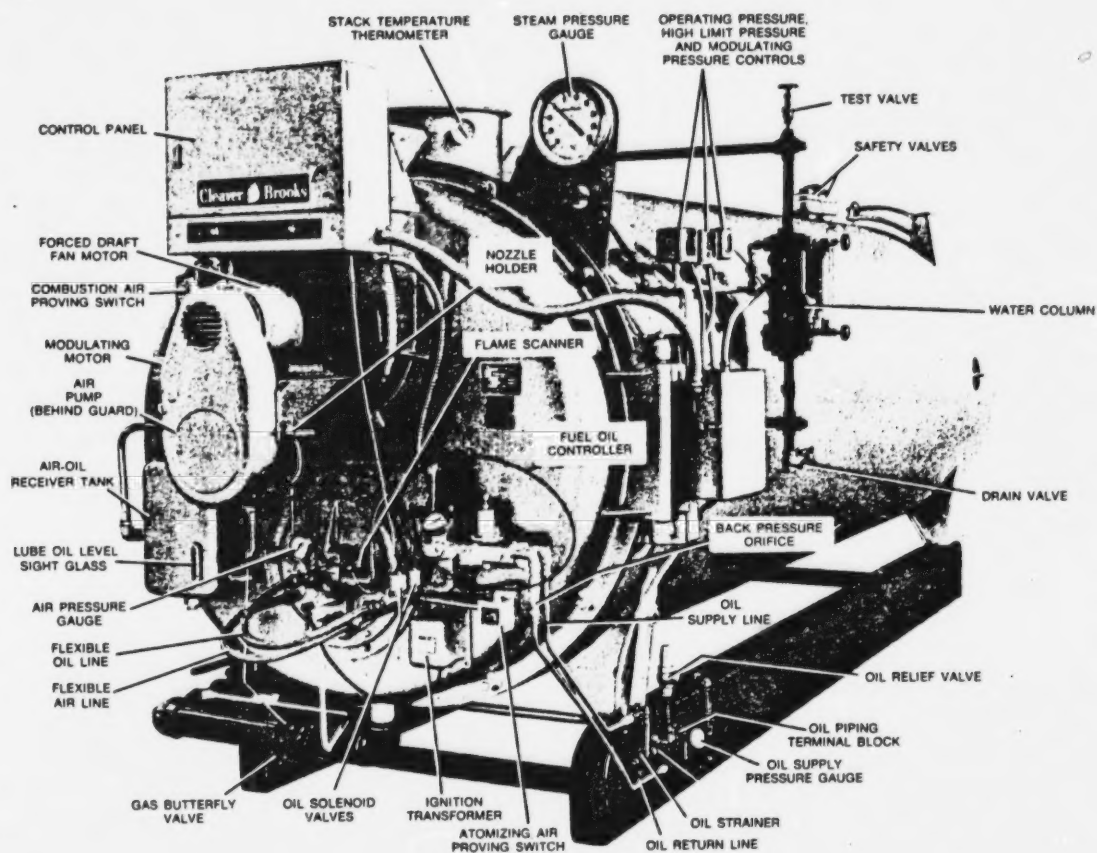


Figure 3. Firetube boiler -- site B.

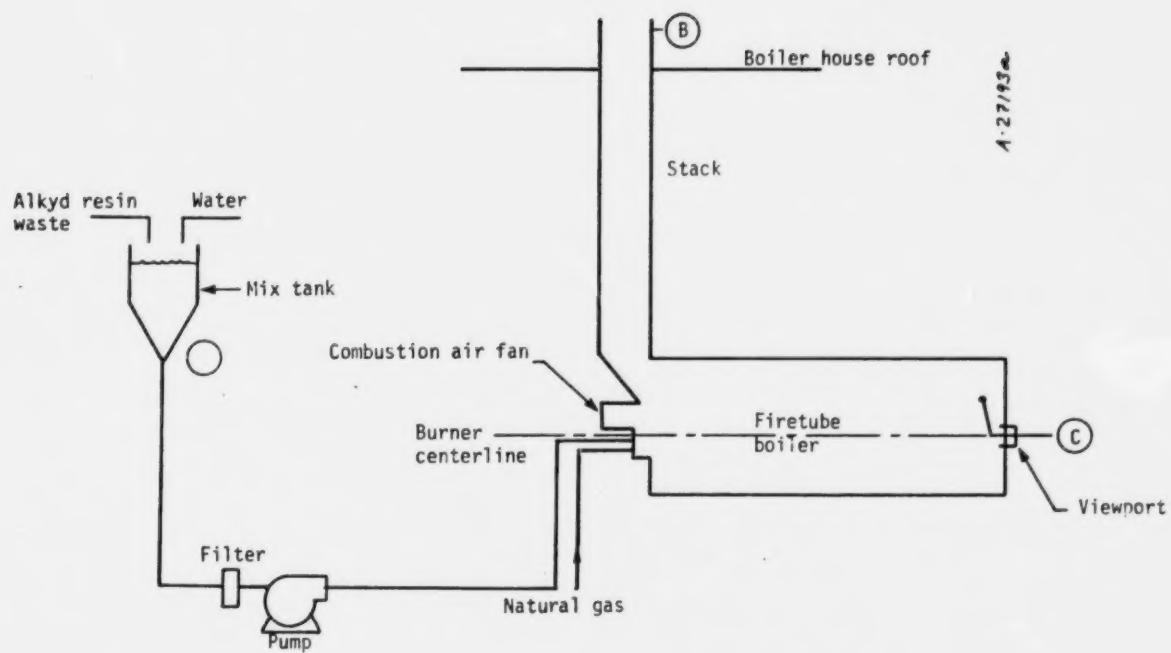


Figure 4. Sampling locations -- site B.

TABLE 2. SAMPLING AND ANALYSIS MATRIX -- SITE B

Location	Type of sample/equipment	Analyses
A -- Waste mixing tank	Grab -- composite sample of contaminated wastewater	Organic GC/FID and GC/MS of POHC's
B -- Stack	Grab -- Tenax train	Volatile organics
	Grab -- modified EPA Method 5 with XAD-2 sorbent	Semi- and nonvolatile organics and particulate matter
	Continuous gas monitors	O ₂ , CO ₂ , CO, NO, NO _x , TUHC

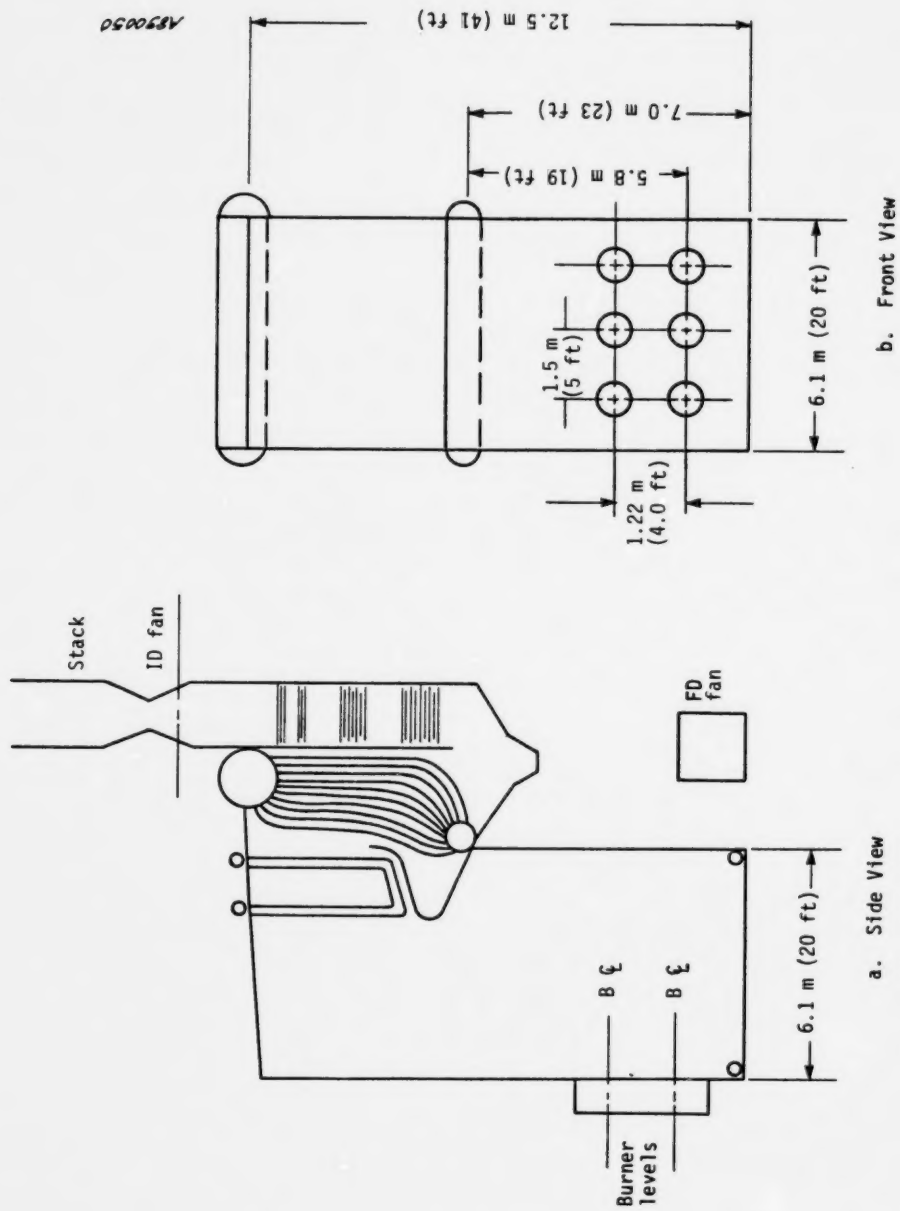


Figure 5. Schematic of B&W steam generator
(dimensions not to scale) -- site C.

TABLE 3. SAMPLING AND ANALYSIS MATRIX -- SITE C

Location	Type of sample/equipment	Analyses
A -- Phenol plant	Grab -- composite sample of phenol waste	Proximate, ultimate analyses, and organic GC/FID ^a and GC/MS ^b of POHC's
B -- Stack	Grab -- Tenax train	Volatile organics by GC/MS
	Grab -- modified EPA Method 5 with XAD-2 sorbent	Semi- and nonvolatile organics by GC/MS
	Continuous gas monitors	O ₂ , CO ₂ , CO, NO, NO _x , TUHC

^aGC/FID -- Gas chromatography with flame ionization detection

^bGC/MS -- Gas chromatography/mass spectrometry

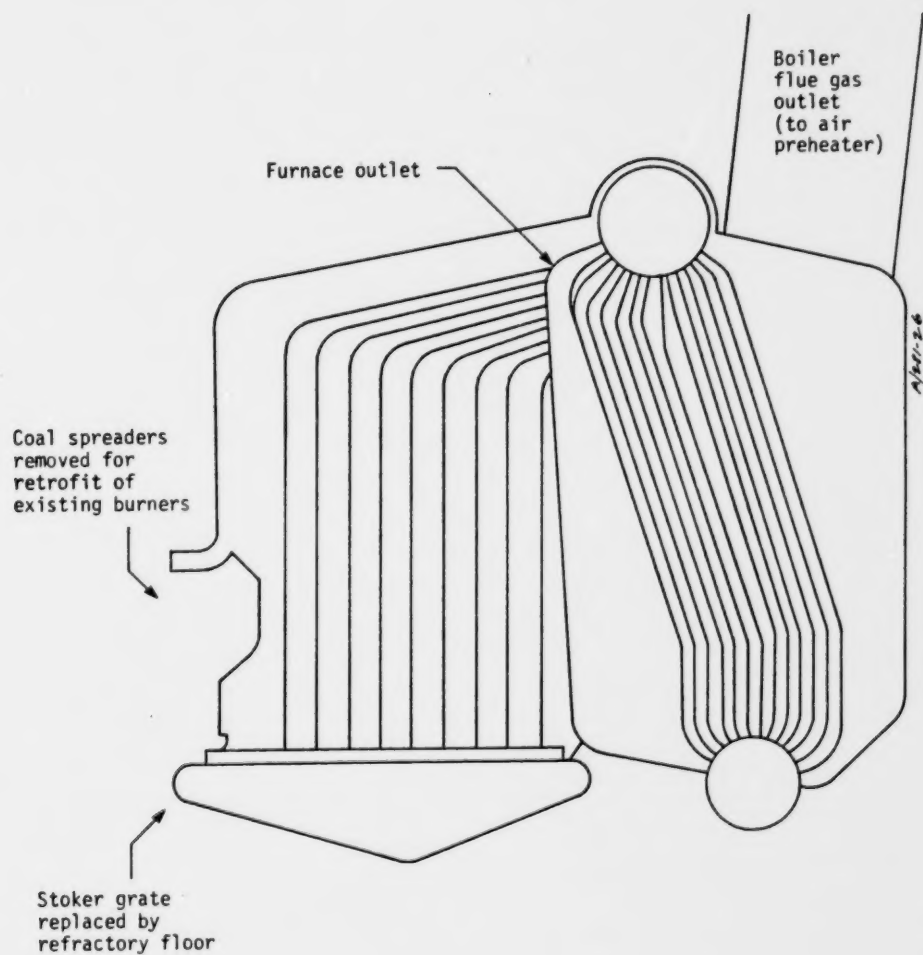


Figure 6. Schematic of B&W boiler -- site D.

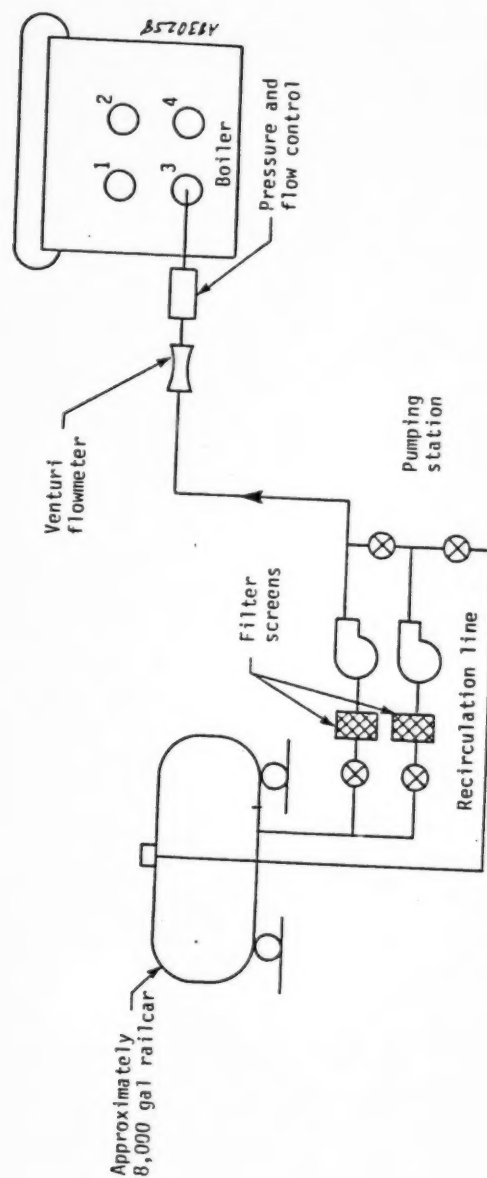
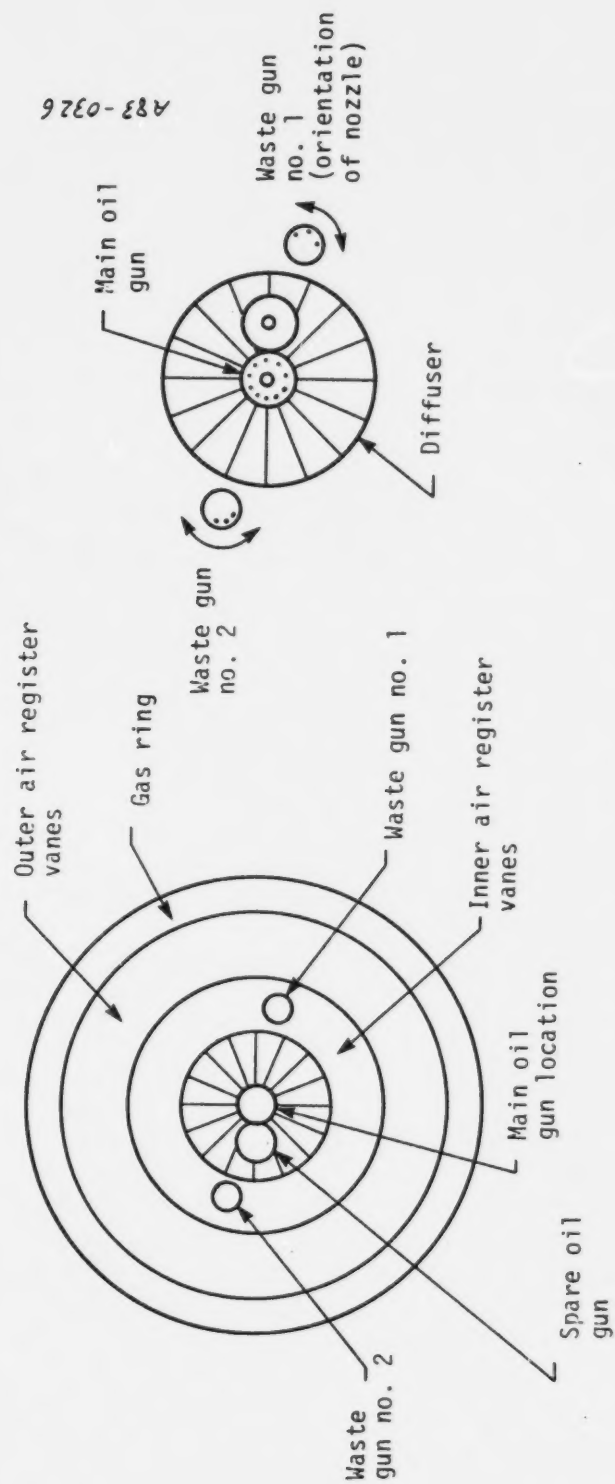


Figure 7. Schematic of waste solvent feed system -- site D.

TABLE 4. SAMPLING AND ANALYSIS MATRIX -- SITE D

Location/stream	Type of sample/equipment	Analysis
Stack/flue gas	Continuous monitors	O ₂ , CO ₂ , CO, NO/NO _x , SO ₂
	Modified EPA Method 5	Semivolatile and nonvolatile organics by GC/MS
	Tenax -- GC system	Particulate matter by gravimetry
	Modified EPA Method 6	Volatile organics
	Grab sample	HCl by titration with silver nitrate C ₁ to C ₆ hydrocarbons by GC/FID
Oil heater/fuel oil	Composite grab sample	G, H, N, O, S, chloride and HHV by ultimate analysis ASTM methods
Burner/waste solvent	Composite grab sample	POHC's by GC/Hall
		Total chloride, ASTM P808 C, H, N, O, S, and HHV by ultimate analysis ASTM methods



a.

b.

Figure 8. Schematic of burner and fuel gun locations -- site E.

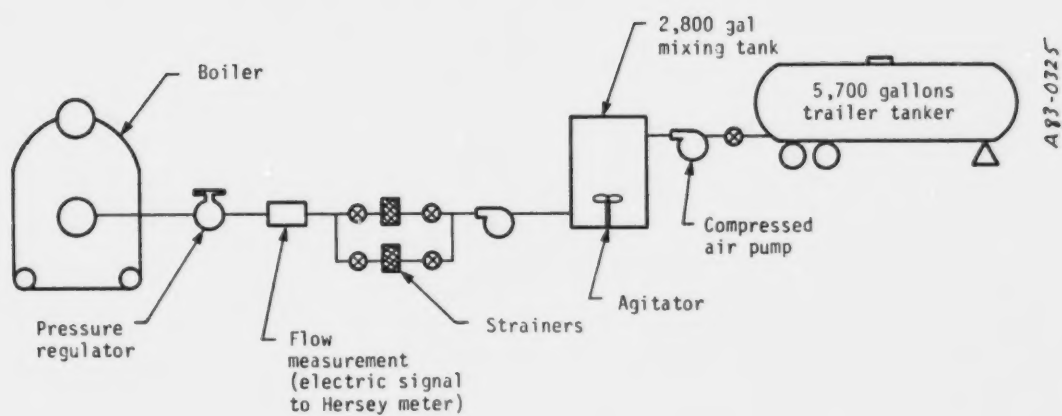


Figure 9. Schematic of waste fuel feed system -- site E.

TABLE 5. SAMPLING AND ANALYSIS MATRIX -- SITE E

Location/stream	Type of sample/equipment	Analysis
Stack/flue gas		O ₂ , CO ₂ , CO, NO/NO _x , SO ₂
	Continuous monitors	Semivolatile and nonvolatile organics by GC/MS
	Modified EPA Method 5	Particulate matter by gravimetry
		Volatile organics
Oil heater/fuel oil	Tenax -- GC system	HCl by titration with silver nitrate
	Modified EPA Method 6	C ₁ to C ₆ hydrocarbons by onsite GC/FID
	Grab sample	
Burner feed line/ waste fuel	Composite grab sample	C, H, N, O, S, chloride and HHV by ultimate analysis ASTM methods
		POHC's by GC/Hall and GC/FID
	Composite grab sample	Total chloride, ASTM P808 C, H, N, O, S, and HHV by ultimate analysis ASTM methods

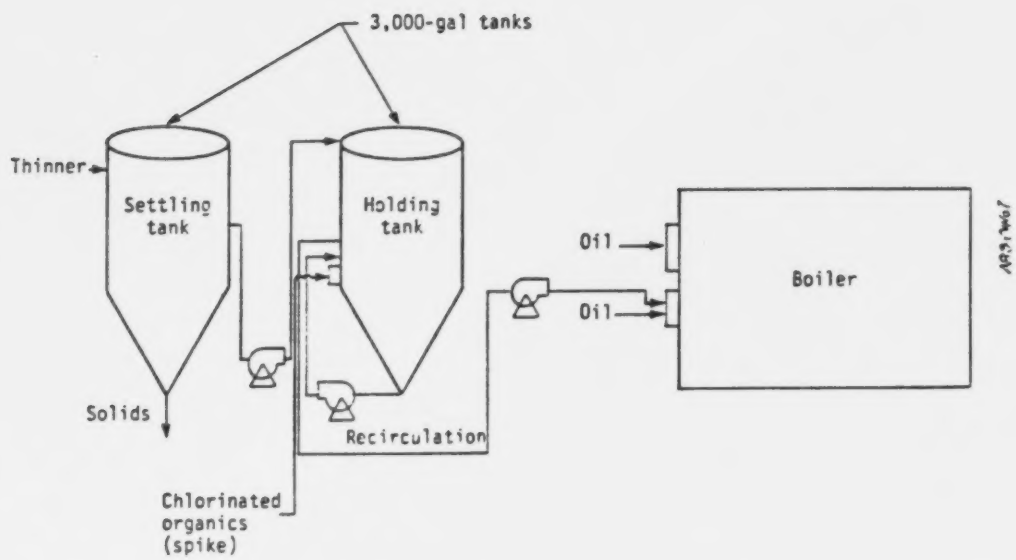


Figure 10. Boiler and feed system -- site F.

TABLE 6. SAMPLING AND ANALYSIS MATRIX -- SITE F

Location/stream	Type of sample/equipment	Analysis
Stack/flue gas	Continuous monitors	O ₂ , CO ₂ , CO, NO/NO _x ,
	Modified EPA Method 5	Semivolatile organics by GC/MS
		Particulate matter by gravimetry
	Tenax -- VOST train	Volatile organics
	Modified EPA Method 6	HCl by titration with silver nitrite
Oil feedline/fuel oil	Composite grab sample	C, H, N, O, S, chloride and HHV by ultimate analysis ASTM methods
Burner feed line/waste fuel	Composite grab sample	POHC's by GC/MS
		C, H, N, O, S, chlorine, and HHV by ultimate analysis ASTM methods

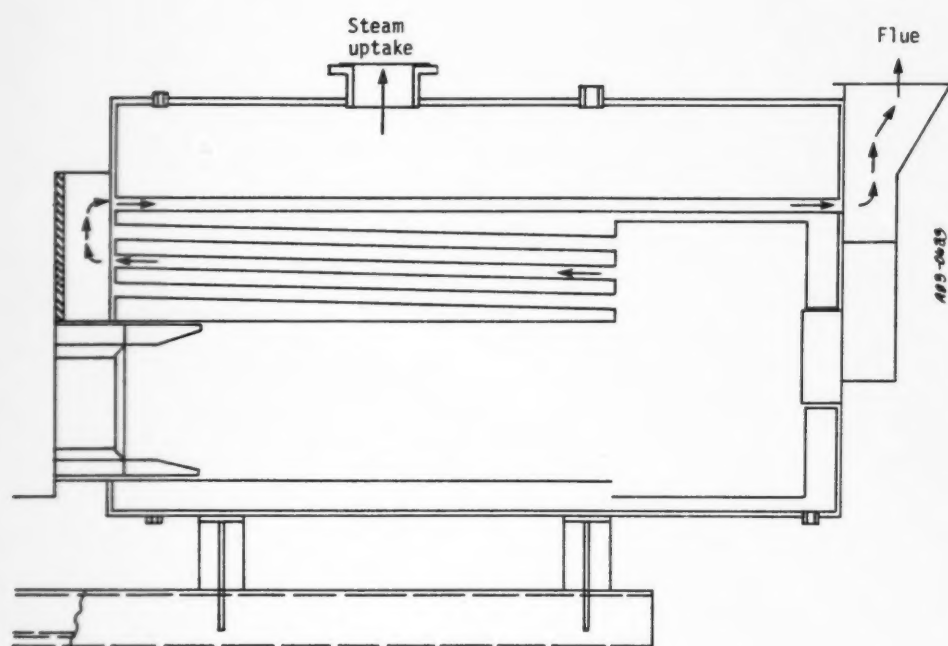


Figure 11. Schematic of three-pass firetube boiler -- site G.

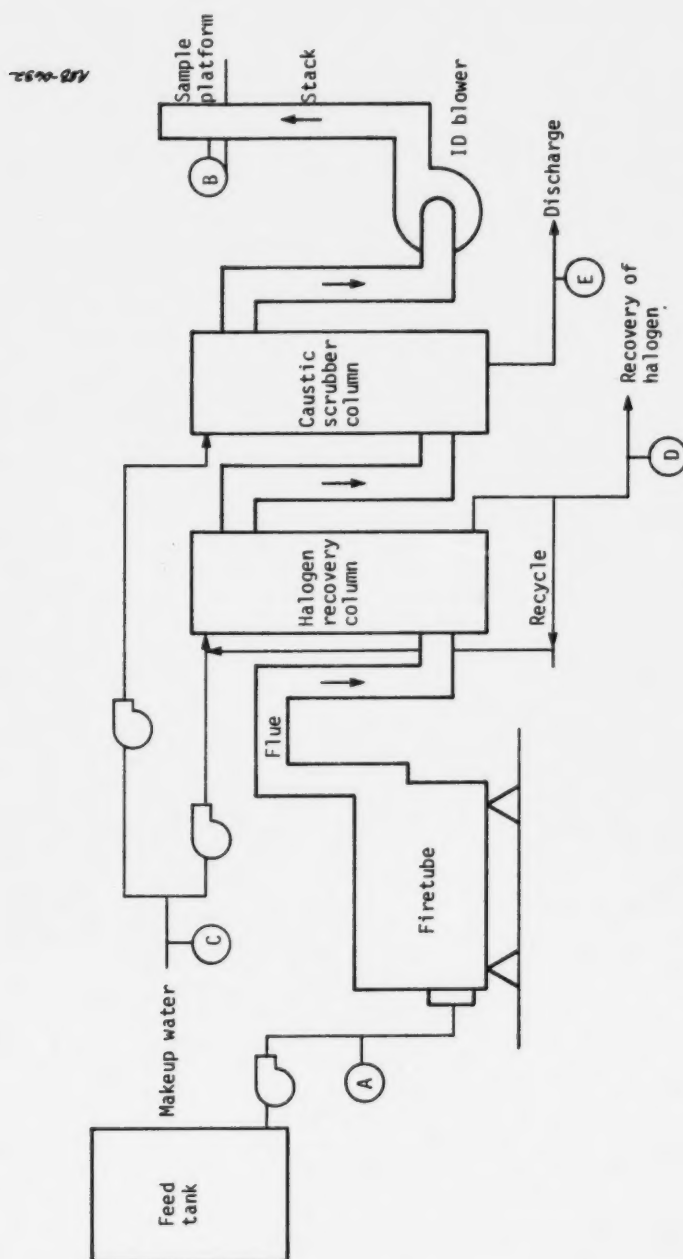
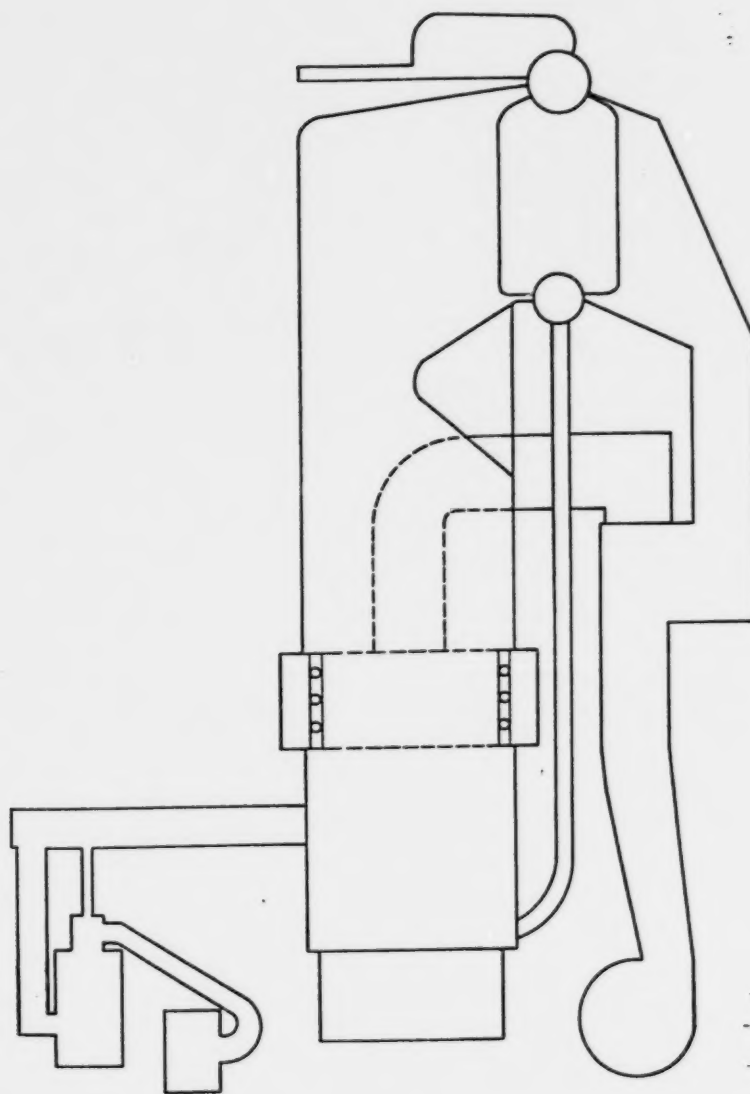


Figure 12. Thermal heat recovery oxidizer (THROX) system layout -- site G.

TABLE 7. SAMPLING AND ANALYSIS MATRIX -- SITE G

Location/stream	Type of sample/equipment	Analysis
Stack/flue gas	Continuous monitors	O ₂ , CO ₂ , CO, NO/NO _x , TUHC
	Modified EPA Method 5	Semivolatile and nonvolatile organics by GC/MS
		Particulate matter by gravimetry
	Tenax-GC system	Volatile organics by thermal desorption into GC/MS
	Modified EPA Method 6	HCl by titration with silver nitrate
	Grab sample	C ₁ to C ₆ hydrocarbons by onsite GC/FID
THROX feedline purge valve	Composite grab sample	Volatile, semivolatile, and nonvolatile organics by GC/FID
		C, H, N, O, S, chloride, ash, moisture, and HHV by ultimate analysis ASTM methods
HCl recovery column discharge and HCl scrubber tower purge line downstream of pumps	Composite grab sample	Volatile organics by GC/FID, using EPA Method 601
		Total chloride
HCl scrubber column makeup stream	Single grab sample	Volatile organics by purge and trap into GC/FID, using EPA Method 601



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Figure 13. Coal-fired boiler -- site H.

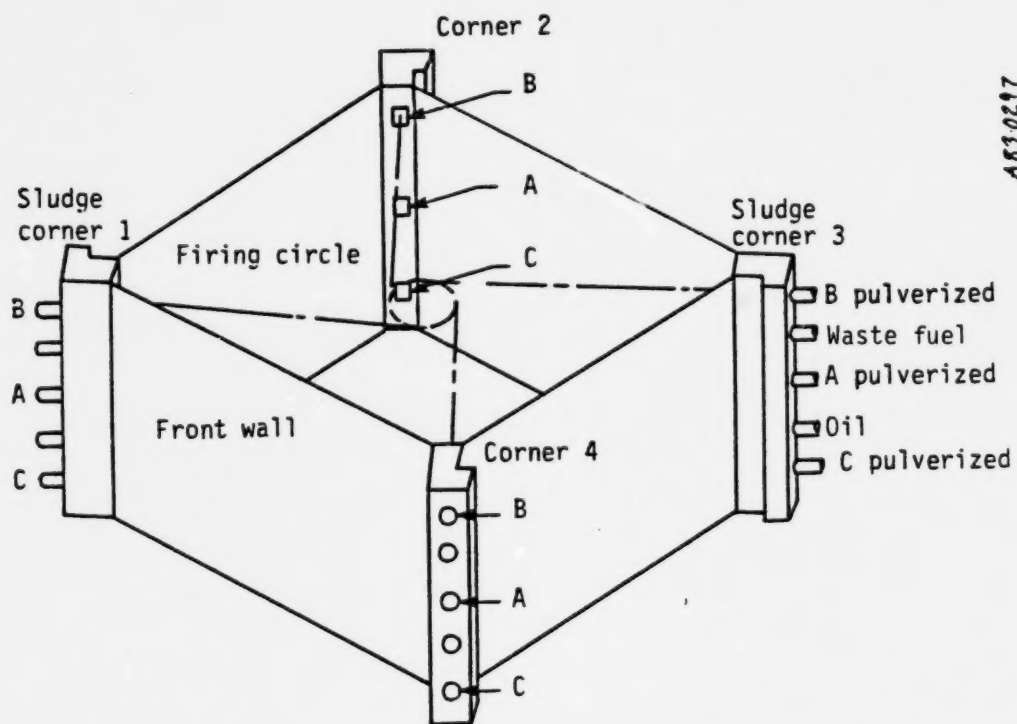


Figure 14. Burner configuration -- site H.

TABLE 8. SAMPLING AND ANALYSIS MATRIX -- SITE H

Location/Stream	Type of Sample/Equipment	Analysis
Stack Flue Gas	Continuous monitors Modified EPA Method 5 Tenax -- GC system Modified EPA Method 6 Grab sample	O ₂ , CO ₂ , CO, NO/NO _x , SO ₂ , TUHC Semivolatile and nonvolatile organics by GC/MS Particulate matter by gravimetry Volatile organics by GC/MS or GC/Hall HCl by titration with silver nitrate C ₁ to C ₆ hydrocarbons by GC/FID
Coal Scales/ Coal	Composite grab sample	C, H, N, O, S and HHV by ultimate analysis ASTM methods
Waste Mixture Spiked Methyl Acetate	Composite grab sample	Semivolatile and nonvolatile organics by GC/FID and GC/MS or GC/Hall Total chloride, ASTM P808 C, H, N, O, S, and HHV by ultimate analysis ASTM methods
ISP Hoppers/ Flyash	Composite grab sample	Nonvolatile organics by GC/FID and GC/MS or GC/Hall

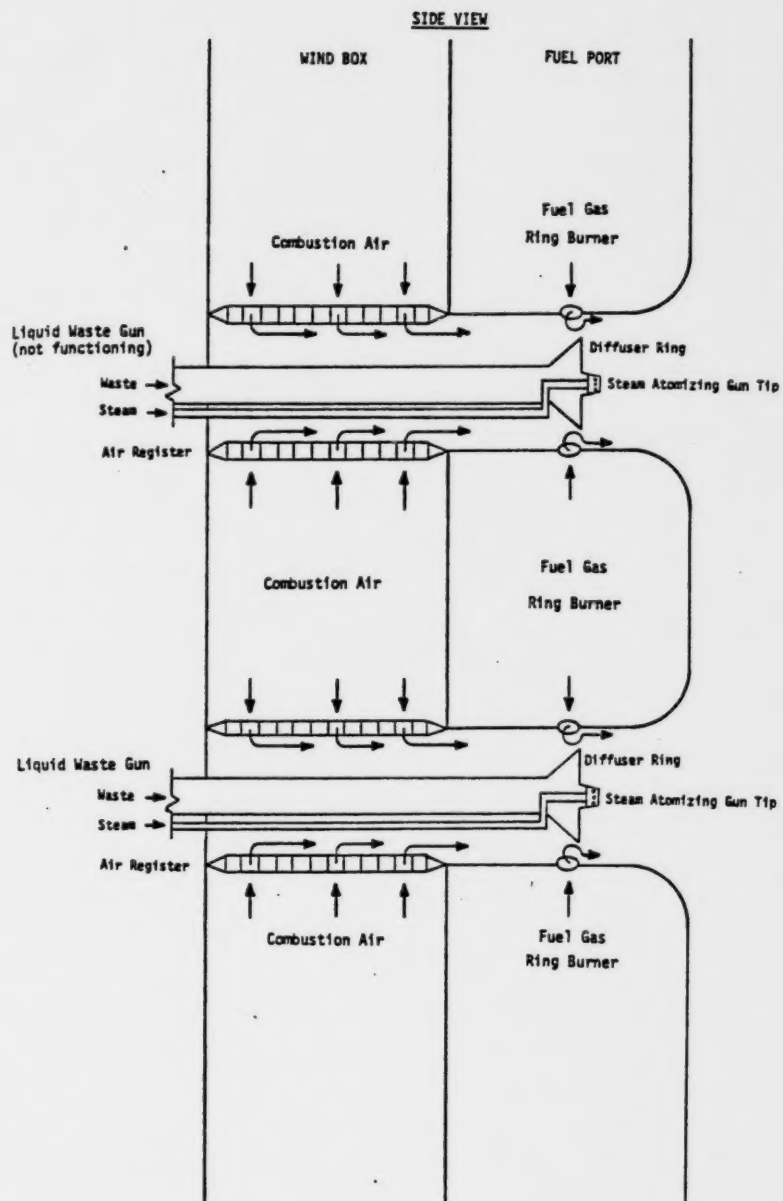


Figure 15. Schematic of waste fuel burners -- site I.

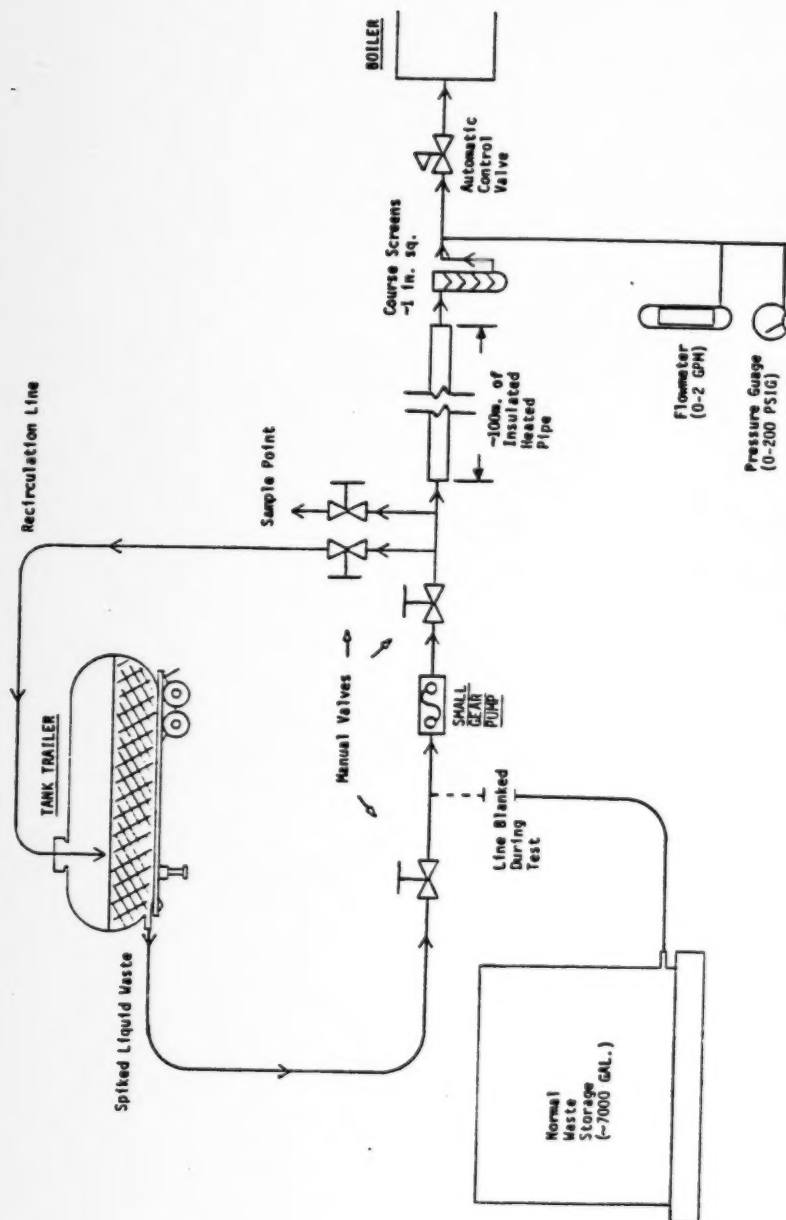


Figure 16. Liquid waste feed system -- site I.

TABLE 9. SAMPLING AND ANALYSIS MATRIX -- SITE I

Sample	Analyze for	Analysis method		Sampling method
		Field	Laboratory	
Waste	liquid volatiles semivolatiles	GC/EC	GC/FID GC/MS	8-½ hour grab samples
Fuel/ Waste	C, H, heating value	-	-	
FG	volatile POHCs and PICS	-	GC/MS	VOST
FG	semivolatile POHCs and PICS, velocity, H ₂ O, particulate	-	GC/FID GC/MS	MM 5
FG	nitrobenzene, aniline	GC/EC	-	6-injections
FG	CO, CO ₂ , O ₂ , NO _x , THC	Various	-	Continuous
FG	HCl	-	IC	Chloride sampling train

Legend:

FG - flue gas
 GC - gas chromatograph
 FID - flame ionization detection
 MS - mass spectroscopy
 EC - electron capture detection
 IC - ion chromatograph
 THC - total hydrocarbons.

TABLE 10. SAMPLING AND ANALYSIS MATRIX -- SITE J

Parameter	Method (Team E)		Method (Team S)	
Stack Gas Flow Rate	EPA Methods 1-4		Stoichiometry	
Fuel Flow Rate	Flow Meter		Flow Meter	
Fuel Composition	GC/FID Analysis		Calculated Based on Fuel Blending	
Excess Air	Orsat Analysis		Orsat Analysis	
Flue Gas Composition	Sample	Analyze	Sample	Analyze
Toluene	MM5	GC/FID	Bag	GC/FID
Chlorobenzene	MM5	GC/FID	Bag	GC/FID
Carbon Tetrachloride	VOST	GC/FID	Bag	GC/FID
Trichloroethylene	VOST	GC/FID	Bag	GC/FID

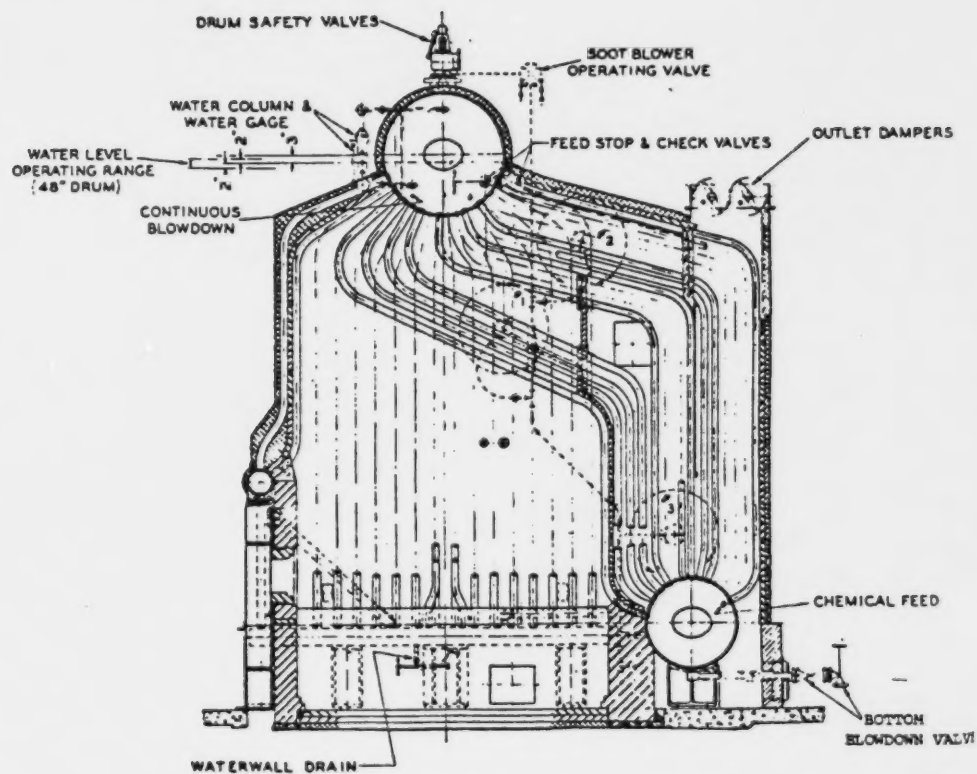


Figure 17. Combustion engineering vertical unit boiler -- site K.

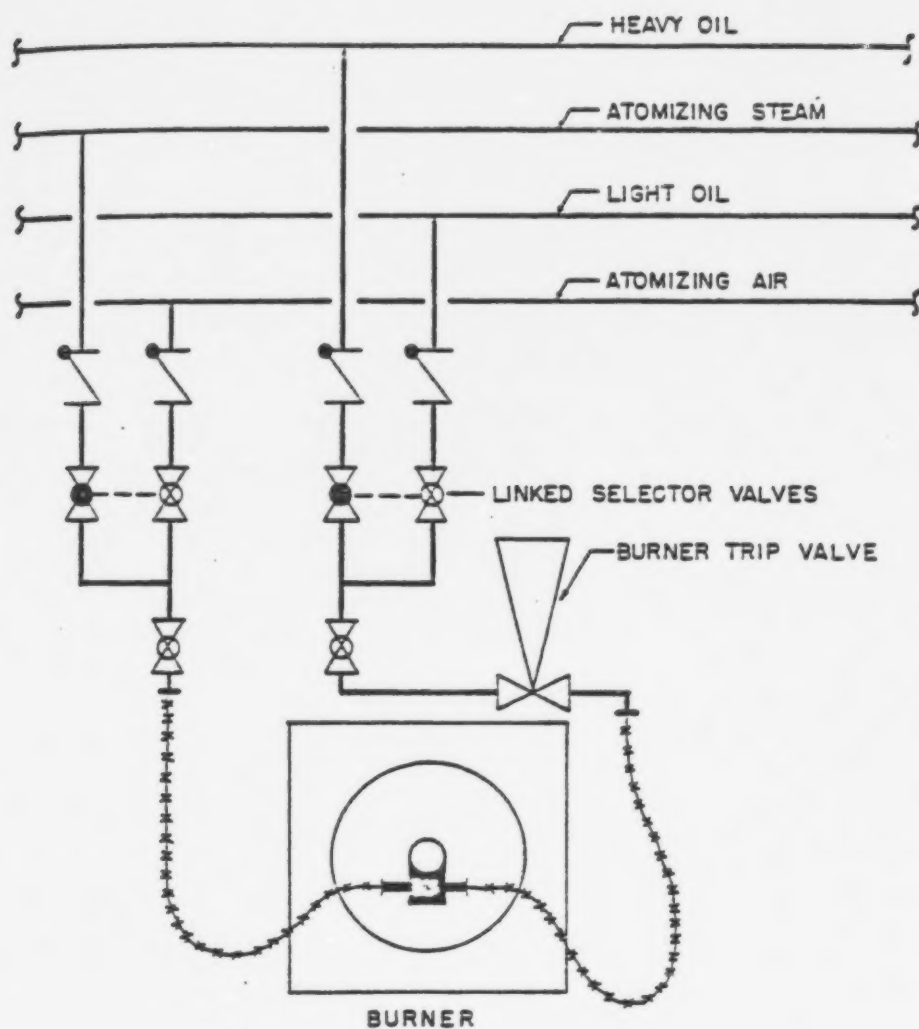


Figure 18. Burner front piping schematic -- site K.

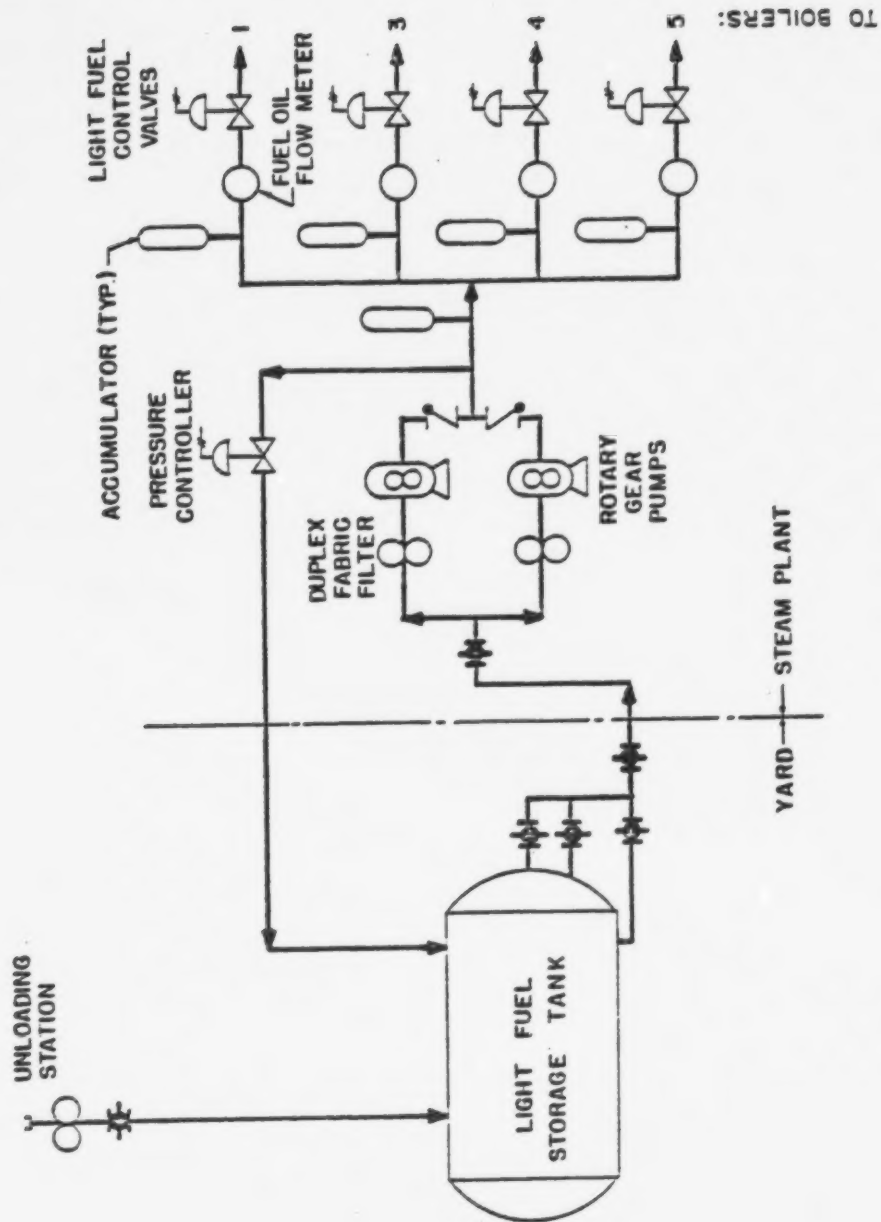


Figure 19. Light fuel oil supply system -- site K.

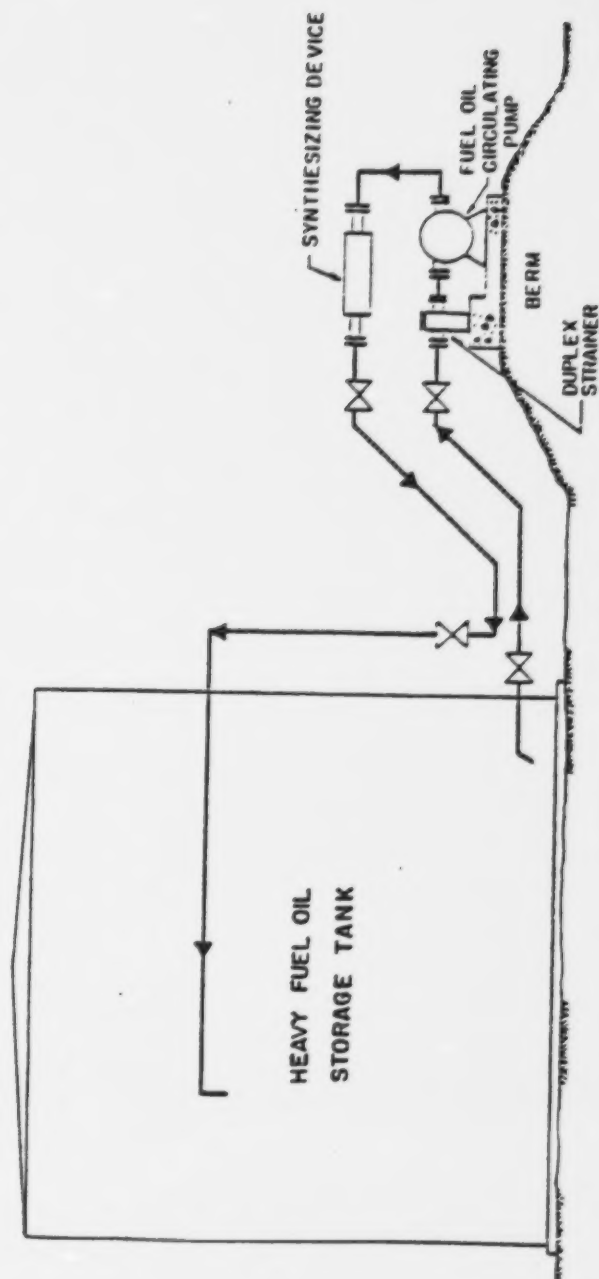


Figure 20. Heavy fuel oil blending system -- site K.

TABLE 11. SAMPLING AND ANALYSIS MATRIX -- SITE K

Sample	Analyze for	Analysis method	Sampling method
Feeds	liquid volatiles, semivolatiles metals chlorine carbon, hydrogen, sulfur heating value, moisture	GC/FID/Hall GC/MS AA ASTM ASTM	8- $\frac{1}{2}$ hour grab samples 4 - VOA's
FG	volatile POHCs and PICs	GC/MS	VOST, 4 pair of traps, 40 mins. each
FG	semivolatile POHCs and PICs	GC/FID GC/MS	MM 5, 4-hr. run, isokinetic traversing
FG	velocity traverse, particulate matter, H ₂ O, density	EPA Methods 1,2,3,4,5	EPA Methods 1,2,3,4,5
FG	metals	AA	EPA Method 5
FG	CO, CO ₂ , O ₂ , SO ₂ , NO _x , THC	Various	Continuous
FG	HCl	IC	Chloride sampling train

2.2 SAMPLING PROTOCOLS

2.2.1 Continuous Monitoring System

Rack-mounted electronic monitors and recorders located in a mobile emissions laboratory were used for the continuous measurement of O₂, CO₂, CO, NO, TUHC and SO₂ at sites A through H. Figure 21 illustrates the continuous flue gas extractive sampling system and monitor arrangement. Flue gas is drawn through an in-stack filter and a heated stainless-steel probe to a gas conditioning and refrigeration system designed to remove water. An unheated line is then used to bring the conditioned gas to the monitors. Calibration gases were used to monitor and correct the drift in the instruments. The calibration gases follow the same path as the flue gas being monitored in that both are conditioned at the stack prior to analysis. Table 12 lists the instrumentation constituting the continuous monitoring and flue gas extractive sampling system used in the test program. Emission levels were recorded on a field data form at 3- to 5-min intervals.

At sites I and K the extractive-type gas monitors also used a gas chromatograph for analyzing stack gas composition. Sample gas was removed from the stack through an in-stack particulate filter using "heat-traced" line to maintain the sample at about 121°C to prevent condensation of water vapor in the sample line. Since the water vapor content of the sample gas was above the practical limits for some of the continuous gas monitors, a commercial sample gas conditioner was utilized to condense and remove the moisture and thus provide a dry gas stream for the CO, O₂, CO₂, NO, and NO_x gas monitors. The total hydrocarbon analyzer uses untreated stack gas, thus giving an analysis on a wet basis as seen in Figure 22.

The sample gas was pumped into a glass sample manifold at a flow rate which exceeds the total sample requirements of the individual gas monitors. The common sampling manifold, therefore, offered slipstream sample flows to each monitor. Maintaining excess sample flow ensured that there were no measurement errors due to back dilution from ambient air. Also, since the sampling manifold was exhausted to ambient pressure the manifold itself remained at ambient pressure and eliminated measurement errors which could arise from varying stack pressures and pressure effects which could arise from varying stack pressures and pressure effects which could be caused by interaction between the gas monitors individual sample pumps.

Sample gas for the gas chromatograph (GC) was continuously pumped from the common sample manifold through a heated injection valve. In such a manner, the fixed sample loop was slushed continuously with stack gas and therefore was representative of the current stack concentrations. Sample injection (i.e., introducing the fixed volume of sample gas from the sample loop into the GC) was performed manually at prescribed intervals.

The gas chromatograph with electron-capture detection (GC/ECD) was operated to determine the levels of the test species, nitrobenzene, and aniline present in the stack gas and liquid feed to the boiler at this site. These data provided a means for calculating the DRE's. A Perkin Elmer 3920

1. In situ filter 0.6u 99.999 percent efficient
2. Exhaust duct
3. 316 stainless steel probe
4. Four pass conditioner-dryer, 316 stainless steel internals
5. 3/8-inch unheated Teflon
6. Teflon-lined sample pump
7. 3/8-inch heated Teflon
8. Rotameter
9. 1/4-inch Teflon tubing
10. Calibration gas manifold
11. Calibration gas selector valve
12. Calibration gas cylinders
13. Backpressure regulator

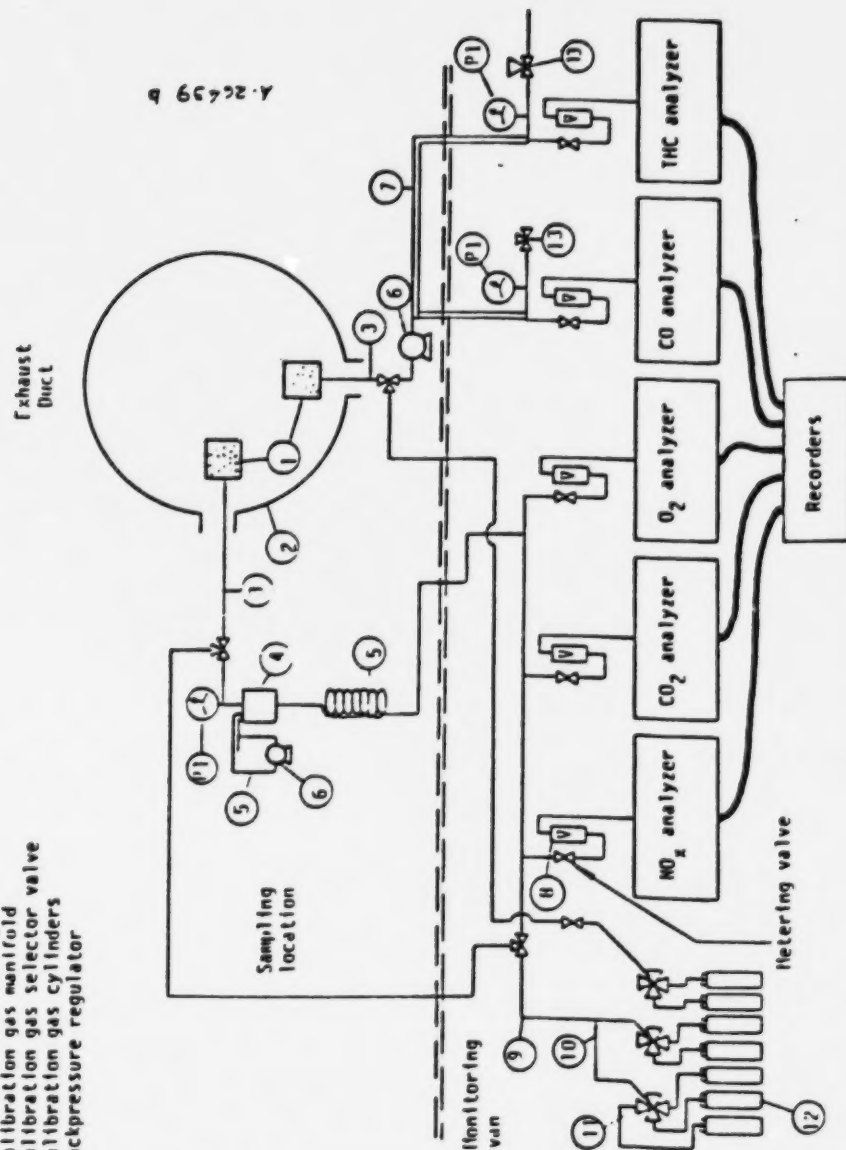


Figure 21. Schematic for continuous extractive sampling system -- sites A through H.

TABLE 12. CONTINUOUS MONITORING EQUIPMENT -- SITES A THROUGH H

Instrument	Principle of Operation	Manufacturer	Instrument Model	Range
NO NO _x	Chemiluminescence	Thermo Electron	10 AR	0 to 100 ppm 0 to 500 ppm 0 to 1,000 ppm 0 to 5,000 ppm
CO	Nondispersive infrared (NDIR)	ANARAD	500R	0 to 1,000 ppm
CO ₂	Nondispersive infrared (NDIR)	ANARAD	AR500	0 to 20 percent
SO ₂ ^a	Pulsed Fluorescence	Thermo Electron	40	0 to 100 ppm 0 to 1,000 ppm 0 to 5,000 ppm 0 to 10,000 ppm
O ₂	Fuel cell	Teledyne		0 to 5 percent 0 to 25 percent
TUHC ^b	Flame ionization (unheated)	Beckman	400	0 to 1,000 ppm
Sample gas conditioner	Refrigerant dryer-condenser	Hankinson	E-4G-SS	10 scfm
Strip chart recorder	Dual pen analog	Linear	400	0 to 10 mV 0 to 100 mV 0 to 1V 0 to 10V

^aUsed at sites D, E, and H only^bUsed at sites A, B, C, F, G, and H

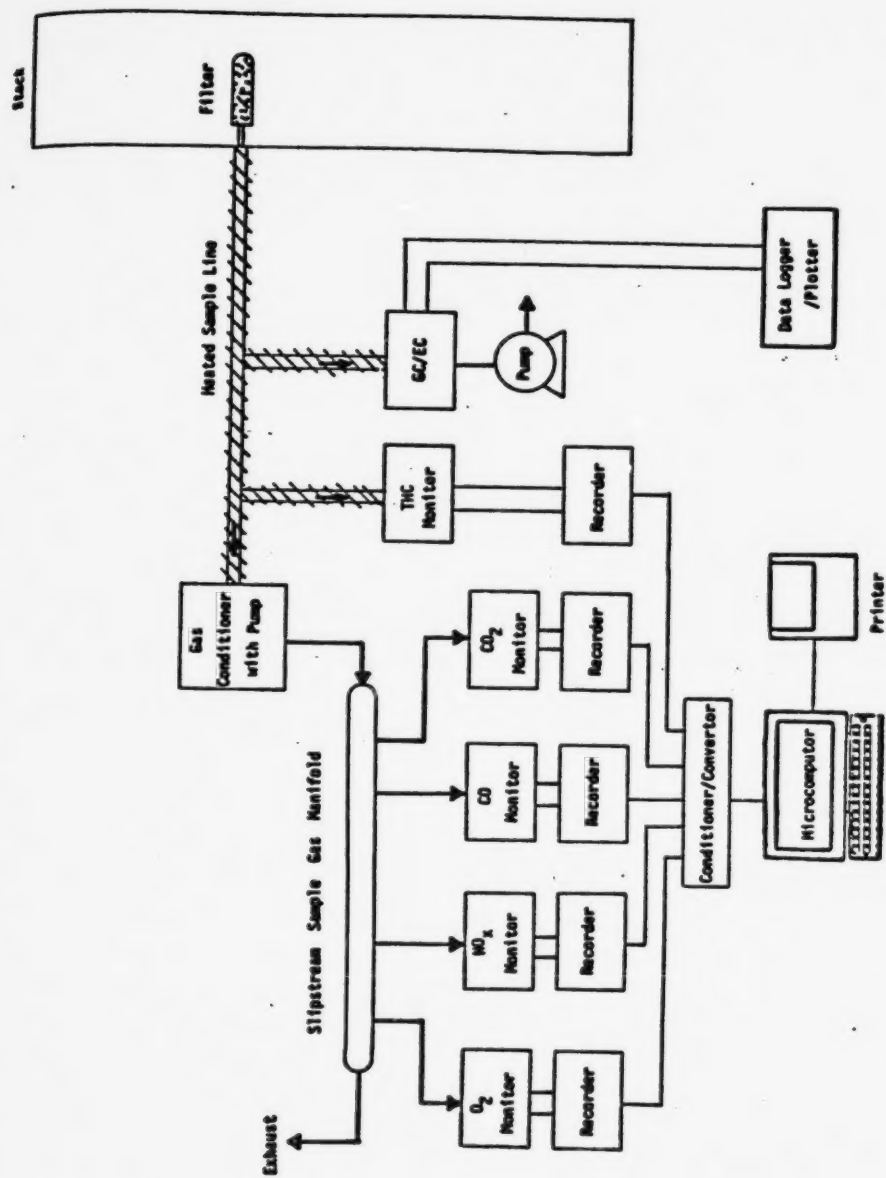


Figure 22. Gas conditioning -- sites I and K.

gas chromatograph with a Ni^{63} electron capture detector was used for the onsite analytical work. A glass column packed with Carbowax 20 M® was used with the necessary temperature program to effect compound separation and detection.

The continuous monitors measured the profiles of the following stack gas constituents over the course of the test: oxygen (O_2), carbon dioxide (CO_2), carbon monoxide (CO), oxides of nitrogen (NO_x), and total hydrocarbons (THC). Oxygen in the sample gas was detected on a dry basis by a gas monitor which employs paramagnetic detection of the oxygen molecule directly. Carbon dioxide and carbon monoxide were measured on a dry basis using monitors which measure the respective species by infrared absorption at a characteristic wavelength using a non-dispersive infrared instrument (NDIR).

The total oxides of nitrogen (NO_x) was quantified on a dry basis by an analyzer which first converts all of the nitrogen oxides present in the sample to nitric oxide which then reacts with a self-generated ozone stream. Detection of the distinctive chemiluminescent wavelength of this reaction yields a measure of the total oxides of nitrogen. The total hydrocarbon content of stack gas was measured on a wet basis with a heated flame ionization detection (FID) analyzer to give a measure of the overall hydrocarbon emissions (in addition to nitrobenzene).

2.2.2 Modified EPA Method 5

Higher molecular weight organics ($>\text{C}_7$ with approximate boiling range $>100^\circ\text{C}$), primarily semivolatile and nonvolatile, were collected using a modified EPA Method 5 sampling system modeled after the system developed by Battelle-Columbus Laboratories. Figure 23 illustrates this sampling system. The XAD-2 organic sorbent in amounts of about 65g was prepacked in the laboratory in a glass module. Prior to field testing, the sampling system was rigorously cleaned in the laboratory using an acid bath solution followed by several rinses using alcohol, methylene chloride, and distilled water. The purpose of this cleaning was to minimize contamination of the gas sample and provide inert surfaces. Specific sampling system parts subjected to this cleaning were: the glass-lined probe, stainless-steel nozzles, Teflon-lined filter holder, condenser, sorbent module, first impinger, and associated tubing.

During field testing at sites A through G both the condenser and the XAD-2 sorbent module were water jacketed to maintain the flue gas temperature entering the XAD-2 sorbent at approximately 60°C (140°F). At sites H through K the ambient temperature was maintained at about 15°C (60°F). The first modified impinger was used to trap organic module condensate. The remaining distilled H_2O and silica gel impingers were used to trap remaining moisture in the flue gas. The convection-heated oven contained only a 142-mm-diameter quartz filter. A cyclone and filter combination was unnecessary because of anticipated low particulate emissions.

Gas sampling was done isokinetically across the stack per EPA Methods 1 through 4. A typical sampling rate of about 280 ml/s (0.6 dscfm) was

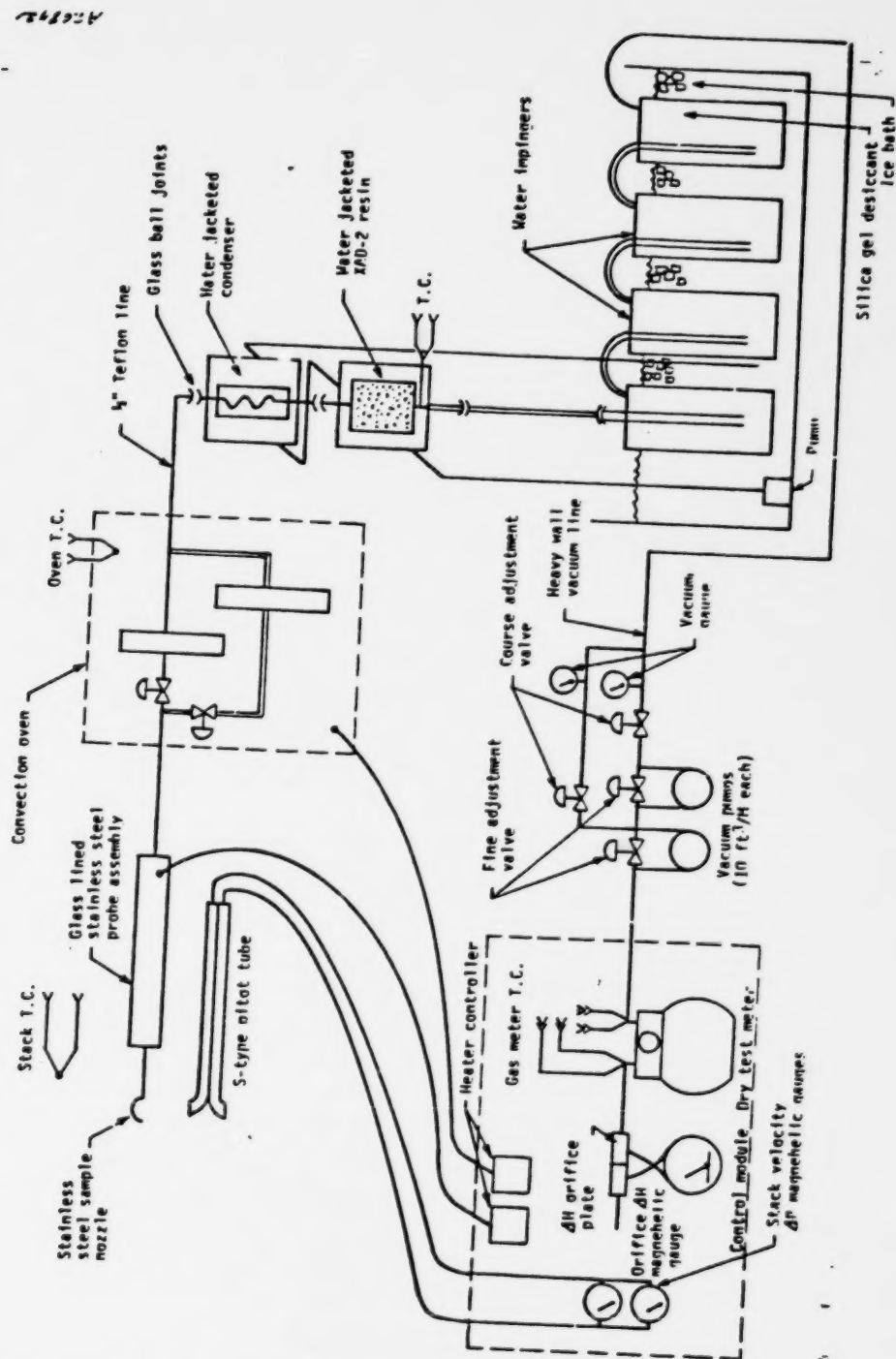


Figure 23. Modified EPA Method 5 train.

adjusted to maintain isokinetic conditions as dictated by stack gas velocity. Total sample volumes were set at approximately 8 dscm (280 dscf) to give organic component detection limits in the range of about 0.1 to 0.6 g/dscm.

2.2.3 Tenax Trains and VOST

A sampling system containing a volatile organic sorbent trap was used to collect low molecular weight volatile organic species (C_7 with approximate boiling range $<100^\circ\text{C}$) and occasionally chlorobenzene ($\text{BP} = 130^\circ\text{C}$) at some sites. At sites D and E a preliminary VOST design was utilized. This system, illustrated in Figure 24, used two organic sorbent traps fabricated using 8-mm ID Pyrex gas chromatographic tubing in 30-cm lengths. Each trap was packed with approximately 1.5g of Tenax GC porous polymer 60/80 mesh. To retain the packing in the tube plugs of silanized glass wool and Swagelock quick connects (normally closed) were fitted at each end. The quick connects were equipped with Teflon or graphite ferrules. Figure 25 illustrates a schematic of a complete Tenax trap. Site E system did not utilize the second empty impinger shown in Figure 23.

At test sites F through K an EPA approved VOST protocol was used. The sampling system is illustrated in Figure 26. This system uses two organic sorbent traps measuring 10 cm by 1.6 cm (ID). The first trap was packed with approximately 1.6g of Tenax GC porous polymer 35/60 mesh. The second trap was packed with 1.0g of Tenax and 1.0g of charcoal. To retain the packing in the tube, plugs of silanized glass wool and swagelock compression fittings were fitted at each end. The quick connects were equipped with Teflon or graphite ferrules. Figure 27 is a schematic of a complete Tenax trap.

Prior to testing, each Tenax trap was conditioned to remove organic compounds. Conditioning generally consisted of baking each trap at 300°C with N_2 purge for an 8-hr period. Subsequently, the trap was desorbed at 200°C with He into GC/FID. If the trap was found to be void of hydrocarbons above 20 ng relative to dg-toluene, that is each chromatographic peak was less than 20 ng, then the trap was considered ready for use in testing. Conditioning was repeated if the trap failed the QC check.

In the field, prior to the start of each test the entire system was leak checked. For the sampling system used at sites I and E, this required plugging the inlet to the first impinger trap and evacuating the entire system. Since the leak check introduced some inherent contamination from ambient air passing through the Tenax traps, fuel test blanks at sites I and E were subjected to the same leak check procedure. Three sets of Tenax samples were taken for each test. For each set a total gas sample of 6 liters was taken usually over a 20-to 30-min period. Start and stop times were recorded by the operator and any sample rate excursion was corrected by adjusting the valve on the rotometer. Impinger condensate was recovered when collected during the test. Impinger rinse with methanol and distilled water was added to the condensate when available.

For sites F through K, field blank traps were not subjected to leak check procedures. Field blanks were opened to the atmosphere during VOST

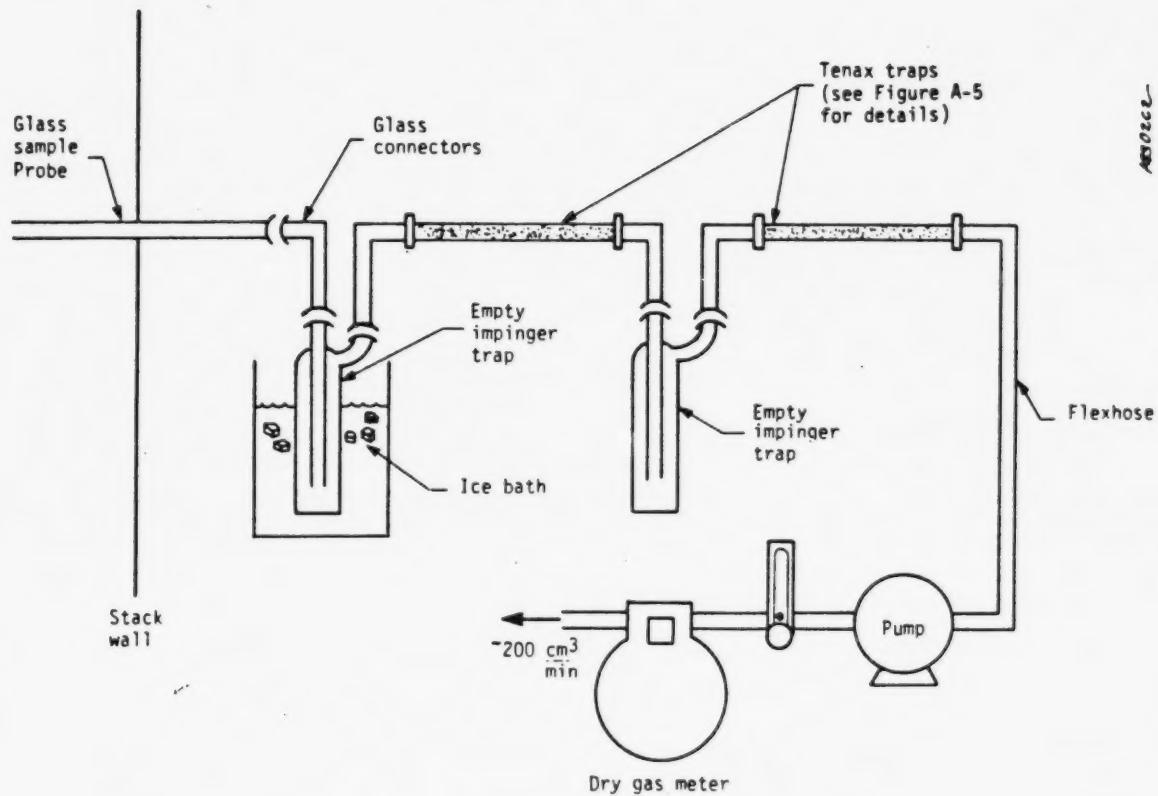


Figure 24. Volatile organic sampling train -- site D.

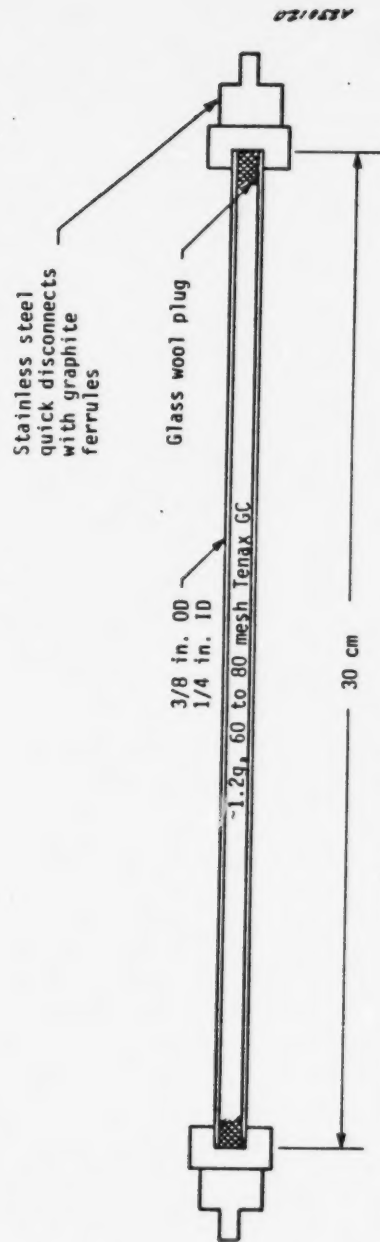


Figure 25. Schematic of tenax trap construction -- sites D and E.

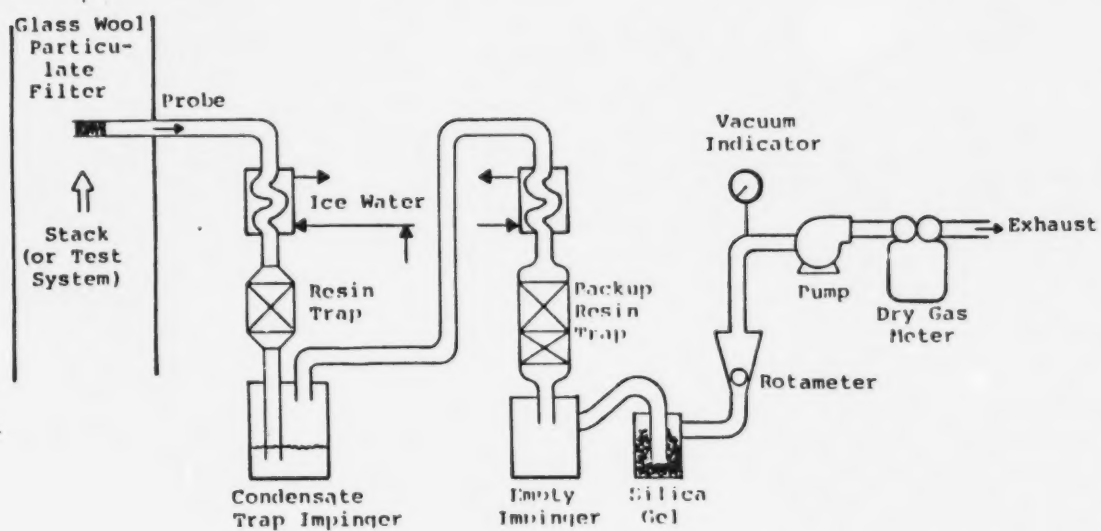


Figure 26. Schematic of volatile organic sampling train -- sites F through K.

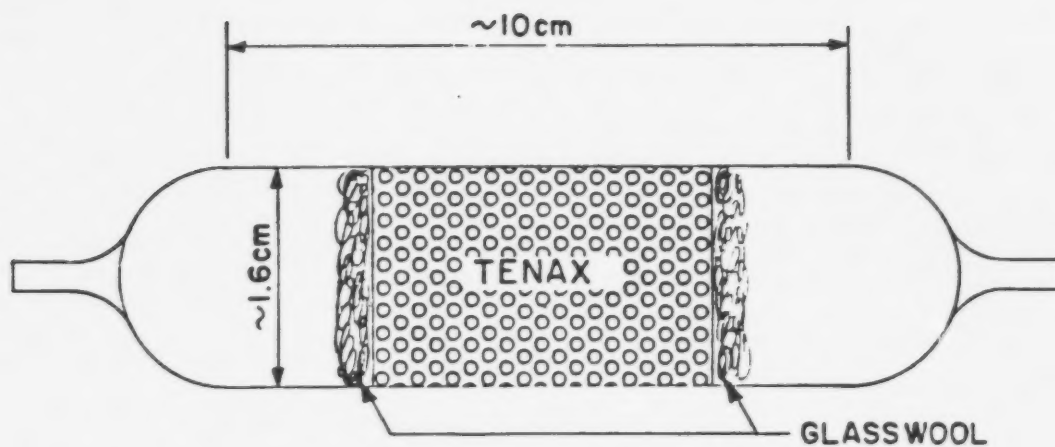


Figure 27. Schematic of tenax trap construction.

preparation at the stack. Sample volumes with the VOST varied from 10 to 20 liters generally over a 20- to 40-min sample duration.

2.2.4 Other Sampling Systems

2.2.4.1 Modified EPA Method 6

At sites D through K the sampling method for measurement of HCl emissions utilized a modified EPA Method 6 sampling system illustrated in Figure 28. Diluted NaOH (0.1N) in 100-ml quantities was used in the first two regular largest impingers as the absorbing solution for HCl. Impinger no. 3 contained 100 ml of 3 percent H₂O₂ solution which served to remove SO₂ from the gas. The fourth impinger served as a trap to remove moisture from the flue gas. The glass probe was attached to the first impinger by a right angle glass adaptor. The sampling rate was set at 2.0 l/min and a typical sample of about 30 scf was taken.

Chloride ions were measured in the laboratory by titration of the modified EPA Method 6 impinger solution or by specific ion electrode analysis. Acid titration was performed using a standard solution of silver nitrate using bromphenol blue diphenylcarbazole mixed indicator. Blank impinger solutions were also analyzed to measure the relative background levels.

2.2.4.2 C₁ - C₆ Sampling and Analysis

At test sites D, E, and G samples for hydrocarbon analysis were collected using the apparatus diagramed in Figure 29. The equipment consisted of a nonheated 0.25 in. (O.D.), stainless-steel probe fitted with an 0.7- m sintered, stainless-steel filter attached to the probe inlet. The outlet of the sampling probe was directly attached to the inlet of a Thomas Teflon-lined, diaphragm vacuum pump. A 500-cm³, stainless-steel, heated sampling cylinder placed on the outlet of the pump was used to collect this sample under pressure.

Sampling cylinder construction consisted of specifically wrapping each assembly with a 6-ft, heavily insulated, 576-watt, heat tape powered by a percentage voltage controller. A type K (Alumel/Chromel) thermocouple implanted on the metal surface of the sampling cylinder was used to monitor the cylinder temperature during operation. To ensure even and efficient heating of the sample cylinder each unit was covered with approximately 0.75-in. of ceramic fiber insulation.

Prior to flue gas sampling, the sampling cylinders were preconditioned by heating each unit to approximately 300°F and purging with zero air (grade 0.1) for 10 min. To extract a flue gas sample the assembled apparatus was positioned and allowed to preheat to the desired sampling temperature (250 to 300°F). Once up to temperature the diaphragm pump was started and the sampling cylinder was alternately pressurized and vented with flue gas to purge the system. Usually 8 to 10 purge cycles were performed with the last

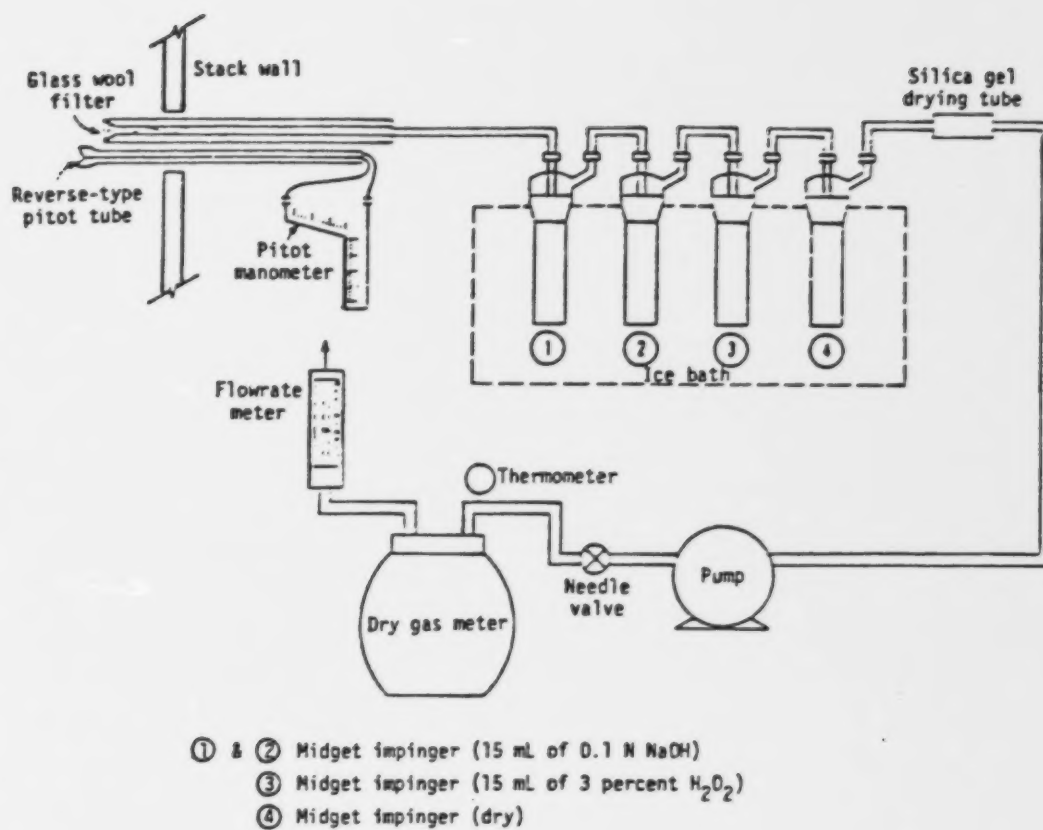


Figure 28. Schematic diagram of hydrogen chloride sampling train.

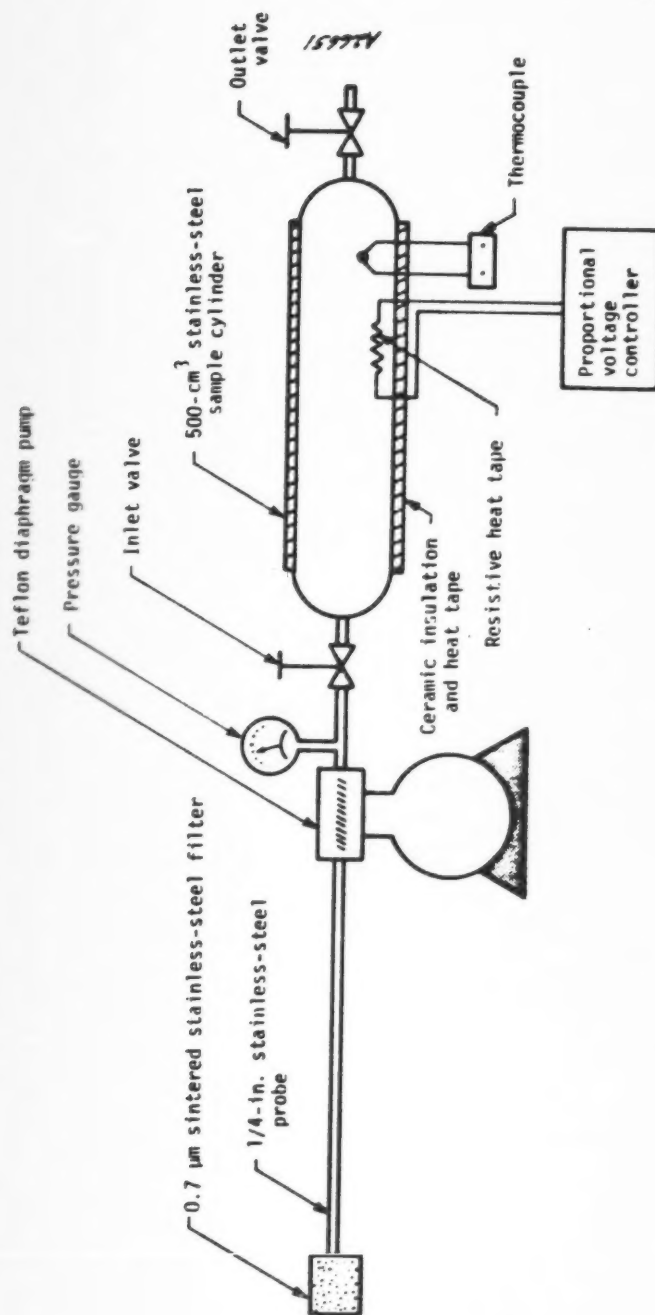


Figure 29. C₁ to C₆ hydrocarbon sampling system -- sites D, E and G.

one being retained for analysis. Final pressure in the sampling cylinder was typically 30 to 50 psia.

The trapped flue gas was then analyzed onsite with a Carle 8,500 gas chromatograph (GC) equipped with a flame ionization detector. Table 13 lists the design specifications of the Carle GC. A 1.85m (6-ft) long, 0.32-cm (1/8-in.) diameter stainless-steel column packed with Porapak Q 60/80 mesh was used to separate the hydrocarbons into their respective components (C₁ and C₆). The GC was calibrated with repeated injections of a Scott Specialty standard gas containing C₁ to C₆ hydrocarbons (each having a concentration of 15 ppm). The chromatographic responses for the standards and the samples were recorded on a Hewlett Packard Model 3390A reporting integrator.

2.3 ANALYSIS PROTOCOLS

2.3.1 Modified EPA Method 5 (Semivolatile Organics)

Particulate emissions and semivolatile organic pollutants were measured in the waste fuel and flue gas samples collected by the modified EPA Method 5. Figure 30 illustrates the general sample preparation and analysis protocol for semivolatile and nonvolatile organic pollutants used for sites A through H.

Prior to organic analysis, the nozzle and probe rinses were combined with the filter and weighed to calculate total particulate catch. This combined sample was then Soxhlet extracted for 8 hr using methylene chloride. Organics trapped in the XAD-2 sorbent were extracted in a similar manner. The condenser rinse and the condensate of the first impinger were combined and extracted by shakeout three times at pH >2 using methylene chloride. All

TABLE 13. GAS CHROMATOGRAPH SPECIFICATIONS

Carle Instruments, Inc., Model 8500 gas chromatograph:

Sensitivity:	5 x 10 ⁻¹² A for 1 mV output
Suppression range:	10 ⁻⁹ A
Noise:	0.5 percent peak to peak on most sensitive range
Time constant:	100 ms on all ranges except "1" range which is 200 ms
Gas required:	Carrier gas (helium) Combustion air Fuel gas (hydrogen)

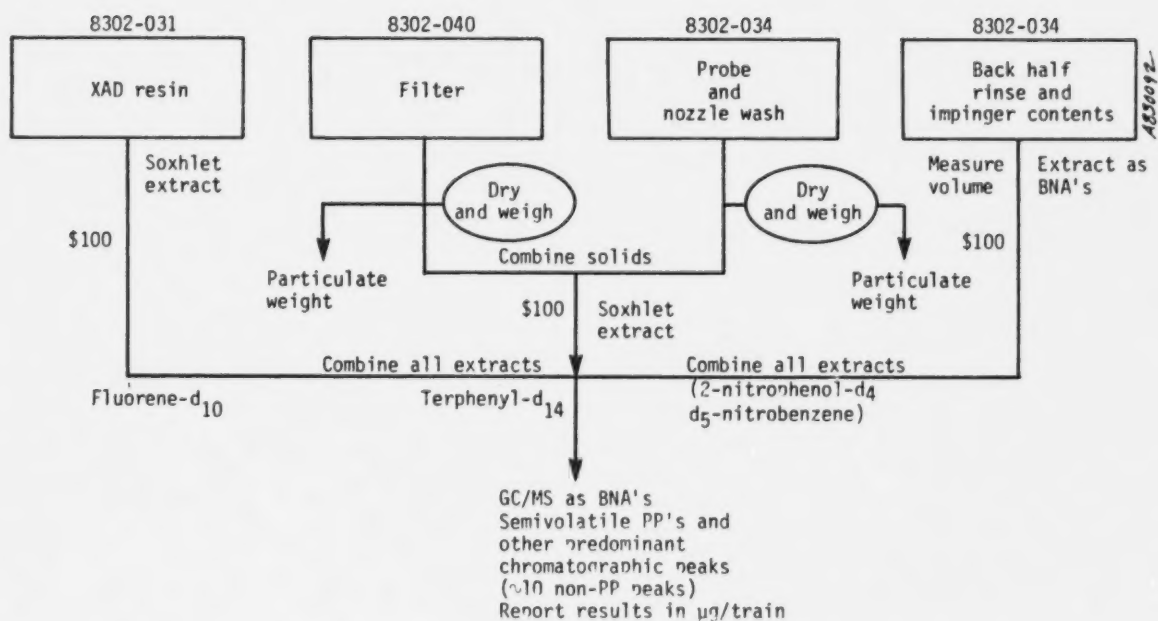


Figure 30. Flow scheme for extraction and analysis of organic samples from MM5 trains -- sites A through H.

modified Method 5 sample extracts were then combined to form one flue gas sample dried over sodium sulfate and concentrated to 1 ml. Waste solvent samples in 50- μ l quantities were diluted to 1 ml also with methylene chloride prior to extraction.

All extracts were analyzed by GC/MS using a 30m fused silica capillary column. Principal semivolatile and nonvolatile organics sought in the analysis were the priority pollutants listed in table 14. In addition, concentrations of major nonpriority pollutants were estimated using response factors for similar components. Table 15 summarizes typical GC/MS operating conditions.

XAD-2 blank exposed to field contaminants in the sample recovery laboratory was analyzed by GC/MS to estimate the background contamination. The results of sample blank analysis were used in determining the actual concentration of compounds in the samples. All emissions results reported were corrected for this background concentration.

At sites I and K the MM5 samples were prepared and analyzed in the following manner.

Container No. 1 (Contents of the second and third impingers from the Modified Method 5 sample train): Note the physical properties of the sample as to color, consistency, presence of solids, and measure the volume and the pH. Spike the sample as necessary with the required surrogate compounds (d_6 phenol and/or d_8 naphthalene[®] for QC purposes. Without adjusting the sample pH, transfer the impinger solution to a 1,000-ml separatory funnel. Rinse the sample container with 20 ml of acetone, followed by two 20 ml portions of methylene chloride, adding the rinses to the separatory funnel. Extract the sample with three separate aliquots of methylene chloride, transferring to a K-D evaporator, first filtering through pre-extracted, dried Na_2SO_4 . The volume is reduced and brought to a known volume so that when analyzed the concentration of the compound of interest falls in the range of the calibration curve. If the compounds of interest are not detected in Container 1, then the contents of Container 1A were not analyzed.

Container No. 1A (Contents of 1st Impinger): Proceed as with Container No. 1, but using aliquots of solvent appropriate for the volume of condensate collected.

Container No. 2 (Methylene chloride, acetone rinse of probe (if appropriate), filter housing, impingers, and any miscellaneous glassware): Note the physical properties of the sample as to color, consistency, presence of solids, and measure the volume. Spike the original solvent sample as necessary with d_6 -phenol and/or d_8 -naphthalene for QC purposes. Proceed with the concentration step as described above for Container No. 1. Analyze the sample by GC/MS.

Container No. 3 (Filter): Note the physical properties of the filter as to color, consistency, and presence of particulates. Place the filter into the thimble containing the XAD-2[®] resin and proceed as described in Section E below.

TABLE 14. COMPOUNDS SOUGHT IN THE GC/MS ANALYSIS AND THEIR DETECTION LIMITS -- SITES A THROUGH H

<u>Acid Compounds</u>			
2,4,6-trichlorophenol	5	2-nitrophenol	5
p-chloro-m-cresol	5	4-nitrophenol	20
2-chlorophenol	5	2,4-dinitrophenol	20
2,4-dichlorophenol	5	4,6-dinitro-o-cresol	20
2,4-dimethylphenol	5	Pentachlorophenol	5
		Phenol	1
<u>Base Neutral Compounds</u>			
1,2,4-trichlorobenzene	1	Benzo(c)phenanthrene	40
1,2-dichlorobenzene	1	Bis(2-chloroethoxy)methane	1
1,2-diphenylhydrazine	1	Bis(2-chloroethyl)ether	1
(as azobenzene)		Bis(2-chloroisopropyl)ether	1
1,3-dichlorobenzene	1	Bis(2-ethylhexyl)phthalate	1
1,4-dichlorobenzene	1	Butyl benzyl phthalate	1
2,4-dinitrotoluene	1	Chrysene	1
2,6-dinitrotoluene	1	Di-n-butyl phthalate	1
2-chloronaphthalene	1	Di-n-octyl phthalate	1
3,3'-dichlorobenzidine	5	Dibenzo(a,h)anthracene	5
3-methyl cholanthrene	40	Dibenzo(c,g)carbazole	40
4-bromophenyl phenyl ether	1	Diethyl phthalate	1
4-chlorophenyl phenyl ether	1	Dimethyl phthalate	1
7,12-dimethyl benz(a)anthracene	40	Fluoranthene	1
N-nitrosodi-n-propylamine	5	Fluorene	1
N-nitrosodimethylamine	NA	Hexachlorobenzene	1
N-nitrosodiphenylamine	1	Hexachlorobutadiene	1
Acenaphthene	1	Hexachlorocyclopentadiene	1
Acenaphthylene	1	Hexachloroethane	1
Anthracene	1	Indeno(1,2,3-cd)pyrene	5
Benzo(ghi)perylene	5	Isophorone	1
Benzidine	20	Naphthalene	1
Benzo(b)fluoranthene	1	Nitrobenzene	1
Benzo(k)fluoranthene	1	Perylene	40
Benzo(a)anthracene	1	Phenanthrene	1
Benzo(a)pyrene	1	Pyrene	1

^aIn nanograms per microliter injected

TABLE 15. TYPICAL GC/MS OPERATING CONDITIONS FOR MODIFIED METHOD 5
TRAIN -- SITES A THROUGH H

• Column:	SE54-30N
• Injector temperature:	260° to 270°C
• Source temperature:	280° to 300°C
• Transfer line temperature:	275°C
• Split flow ml/min:	37
• Sweep flow ml/min:	7
• Temperature program:	300°C (4 min) + 270°C at 10°C/min, 30 min hold at 270°C
• Multiplier voltage:	1,500 to 21,00 eV
• Filament current:	0.5 MA
• Mass range:	35 to 450 amu
• Scan rate:	1 sec/scan
• Total scans acquired:	2,000 to 2,600

Sample Extraction: Sample extractions were performed using distilled-in-glass hexane (Burdick and Jackson) or equivalent. Samples were first concentrated down to 10 ml with a three-ball Snyder column K-D or rotoevaporator. Subsequent concentration down to 1 ml or less was accomplished with a two-ball micro-Snyder column or equivalent. Alternate concentrating procedures were possible if acceptable compound recoveries were demonstrated.

GC Conditions: A Varian 3700 GC was used with a bonded SPB-1 fused silica capillary column, 30 m x 0.26 mm. A split injection of 30 ml/min was used with 2 μ l of the sample injected. A programmed temperature of 40°C for 5 min to 240°C at 10°C/min was used. The injector temperature was kept at 275°C and the flame ionization detector was at 290°C. The carrier gas used was prepurified nitrogen, with make-up flow of 30 ml/min.

Qualitative Identification of Semivolatile Hydrocarbons: Selected samples and diluted raw feed were initially screened by GC/FID to determine the number and intensity of potential peaks of interest. Selected standards were prepared and analyzed by GC/FID to identify tentatively the observed peaks by retention time. Confirmation by GC/MS using a similar column were performed.

Quantitative Measurement of Semivolatile Hydrocarbons: Once the individual compounds were confirmed, a calibration curve and response factors were developed. If necessary, the sample was diluted to bring the concentration level into the range of the standards. The concentration of a particular compound was determined by comparing the area counts of the unknown to those of the standard. The typical minimum detectable limit for semivolatile compounds was 1 to 5 ng per μ l of injected sample.

GC/MS Analysis: Following the qualitative identification by GC/MS of the compounds of interest in either the waste or emission stream from the boiler, the levels of the identified species were measured based on direct calibration using standards of known purity.

External calibration methods, using either the raw response of a standard or the relative response of the standard versus an internal standard as a function of the amount of standard, are widely used in analytical chemistry for quantification. For these methods a series of calibration standards were prepared from reagent material of the compound(s) of interest which span the linear working range of the analytical instrumentation being used. Each of these standards was analyzed using the same conditions as would be used for the actual samples. Table 16 lists the GC/MS conditions for analysis of the MM5 samples.

2.3.2 VOST Analysis (Volatile Organics)

2.3.2.1 Sites D through H

Analysis for the Tenax trap consisted of thermal desorption of each trap into a gas chromatograph interfaced with a mass spectrometer (GC/MS). The

TABLE 16. GC/MS ANALYTICAL CONDITIONS FOR MM5 -- SITES I AND K

Instrument:	Finnigan 4000 Gas Chromatograph/Mass Spectrometer or equivalent
Data System:	INCOS Data System or equivalent
Column:	SE-54 fused silica capillary; 30 m x 0.25 mm
Temperature Program:	-20°C to 260°C ramp at 12°C/minute and hold for 20 minutes
Injection Type:	Direct injection with a 40:1 split ratio
Source Temperature:	250°C
Injector Temperature:	265°C
Scan Range:	Low Mass: 40 High Mass: 450 Scan Rate: 1.0 s/scan
Carrier Gas:	Helium at 1.0 ml/minute

analytical activities for Tenax and Tenax/charcoal traps followed a modified version of the VOST protocol released by EPA.

The following subsections discuss all analytical activities related to analysis of Tenax-GC traps. These activities included trap conditioning, analysis method development, spiking, and thermal desorption as part of the QC protocol for volatile organic analysis implemented for this test program.

Conditioning

The first analytical activity related to volatile organic sampling was the conditioning of the Tenax-GC sorbent in each trap. This conditioning was done to ensure cleanliness of the sorbent for use in sampling. Each trap was conditioned by temperature programming to 250°C for a minimum of 4 hr (typically 8 hr) with a 30 ml/min purge flow of nitrogen (99.95 percent) through the trap followed by cooling for at least one half hour. This cycle was repeated at least four times per trap. The traps were then tested for cleanliness by thermal desorption at 200°C and GC/FID analysis. Conditioning was repeated until the FID analysis did not show any compounds above 20 ng.

Spiking

Prior to thermal desorption and GC/MS analysis, all sample Tenax traps were spiked with 100 ng each of toluene-d₈, using the flash vaporization technique in which the spiking solution is vaporized and carried onto the trap with the carrier gas. For the recovery study, the compounds were spiked directly onto the trap or spiked using the sample spike generation system illustrated in Figure 31. The intake air was filtered through charcoal to remove vapors present in the ambient laboratory air. The intake air was then saturated with water vapor and fortified with hydrogen chloride by bubbling the air through impinger no. 1, which contained hydrochloric acid and was heated by a boiling waterbath. The compounds of interest were injected in methanol solutions into a "U" tube which was heated to a temperature of 100°C by a heating tape. The air stream was passed through a dry impinger cooled in an ice bath. This impinger simulated the knockout impinger used in field sampling to remove excess water vapor from the flue gas. The sample was trapped on a 3/8-in. OD (5 mm ID) x 12 in. glass trap packed with 35/60 mesh Tenax GC. (The traps employed for these experiments were from the same lot as those used for field sampling.) The pump was protected from water and hydrogen chloride vapors by means of impingers no. 3 and 4 containing sodium hydroxide and silica gel. The gas flowrate was controlled at approximately 200 ml/min by means of a rotameter connected to the exit of the pump. This flowrate was the same as that employed for field operations.

Prior to spiking any of the traps, the entire system was leak checked by capping off the connection to the inlet filter and operating the pump at maximum flow. Leaks were assumed to be absent when no bubbles were observed in impinger no. 3. Tenax and Tenax/charcoal traps were spiked with 100 ng of d₈-toluene. Percent recoveries of these compounds ranged from 70 to 110 percent for both types of traps.

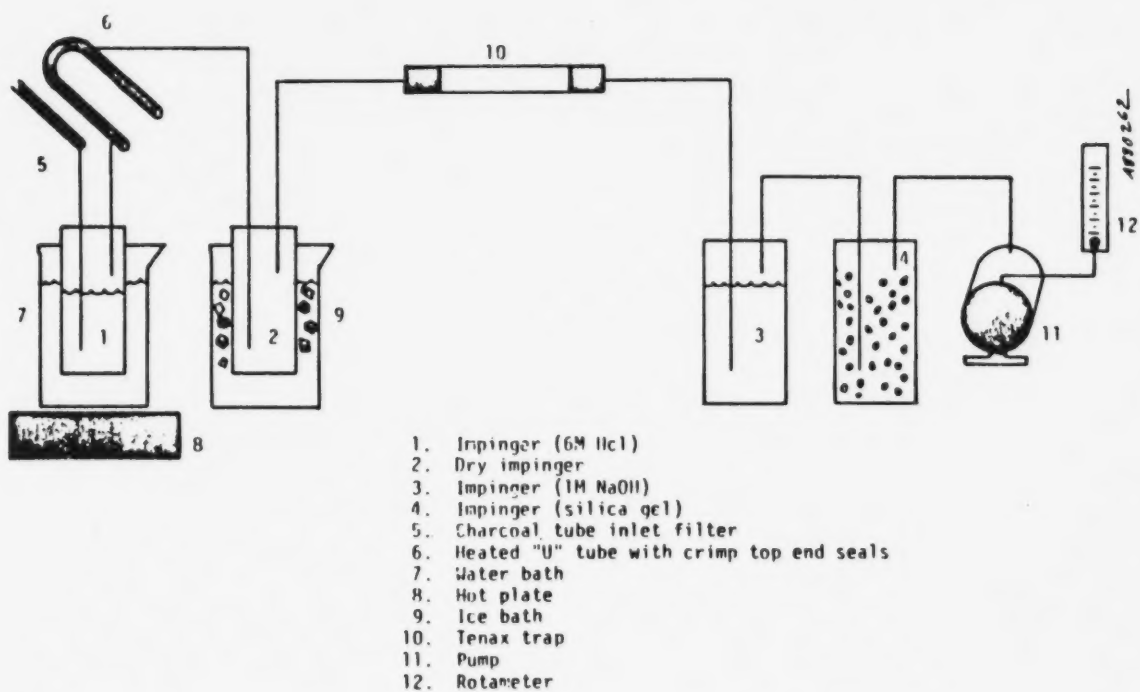


Figure 31. Apparatus for laboratory-scale generation of spiked tenax trap -- sites D through H.

Thermal Desorption and GC/MS Analysis

The Tenax traps were desorbed at 220°C with a helium flow of about 40 ml/min for 10 min onto a 6-ft, 1 percent SP-1000 on Carbopack B (60/80 mesh) gas chromatographic column held at 250°C and held for 10 min. All traps were desorbed and analyzed satisfactorily with the exception of site F traps which, due to their design, showed desorption problems. GC/MS operating conditions are summarized in Table 17. Table 18 summarizes the volatile organics sought in the analysis of Tenax and Tenax/charcoal traps. In some instances, a Hall detector was used for analysis of specific chlorinated organic compounds.

2.3.2.2 Sites I and K

The analytical technique involves the analysis of Tenax® and/or Tenax®/charcoal sampling traps by thermal desorption. A helium purge of the desorbed volatiles was bubbled through a water impinger and collected on a Method 624 analytical trap. Subsequently, this analytical trap was desorbed by the traditional Method 624 procedure and analyzed by GC/MS. The sampling traps were desorbed in a separate oven controlled at 190°C and the volatiles introduced to a standard Teckmar purging apparatus. The minimum detection limit (MDL) for the POHC's was approximately 25 ng per single analyzed tube.

TABLE 17. GC/MS OPERATING CONDITIONS FOR VOST SAMPLE ANALYSIS -- SITES F THROUGH H

• Instrument	Finnigan 1020 GC/MS system interfaced with an INCOS 2300 data system
• Column:	1 percent SP-1000 on Carbopack B 60/80 mesh
• Injector temperature:	220°C (for spiking internal standards)
• Separator temperature:	250°C
• Carrier gas:	Helium at 40 mL/min
• Temperature program:	45°C (3 min hold) to 250°C (10 min hold) at 8°C/min
• Multiplier voltage:	1,200V to 1,400V
• Mass range:	40 to 250 amu
• Scan rate:	3 sec/scan
• Total scans acquired:	700

TABLE 18. VOLATILE ORGANICS SOUGHT IN GC/MS
ANALYSIS -- SITES F THROUGH H

<u>Chlorinated Aliphatics</u>	<u>Chlorinated Ethers</u>
Chloromethane	Epichlorohydrin
Dichloromethane	2-chloroethyl vinyl ether
Chloroform	
Tetrachloromethane	<u>Aldehydes</u>
Chloroethane	Acetaldehyde
1,1-dichloroethane	Acrolein
1,2-dichloroethane	
1,1,1-trichloroethane	<u>Amines and Nitriles</u>
1,1,2-trichloroethane	Acrylonitrile
1,1,2,2-tetrachloroethane	
1,2-dichloropropane	<u>Aromatic Hydrocarbons</u>
Hexachlorocyclohexane	Benzene
Vinyl chloride	Toluene
1,1-dichloroethylene	Ethyl benzene
1,2-dichloroethylene	o-xylene
Trichloroethylene	m-xylene
Tetrachloroethylene	p-xylene
Allyl chloride	
1,3-dichloropropene	
Chloroprene	
<u>Ethers</u>	<u>Chlorinated Aromatics</u>
Ethylene oxide	Chlorobenzene
Propylene oxide	

The virgin Tenax was prepared by Soxhlet extraction with methanol and then with pentane for 24 hours each and dried in a vacuum for 6 hours at 50°C. The charcoal was not prepared by solvent extraction. The tubes were then packed individually and thermally conditioned for 24 hours at 200°C with organic free nitrogen (or helium) flowing at 20 ml/min. Every tube was screened by treating it as a sample and performing the analytical thermal desorption step. Conditioning was repeated until no emissions were observed at the detection limit of 2 ng of benzene and/or toluene by cryo-focusing GC/FID detector.

Before analysis by GC/MS, all traps, including the blanks, were spiked with an internal standard of bromofluorobenzene (BFB) to a total of 750 nanograms per trap. Addition of the internal standard was accomplished by connecting each set of traps (Tenax-Tenax/charcoal) to a gas chromatograph injection port maintained at 150°C. The oven of the GC was at room temperature. Helium flow through the trap was set at 50 cc per minute and a 1 µl aliquot of a 750 ng/µl methanol solution of bromofluorobenzene was injected using the solvent flush technique. After injection, the gas flow was maintained for 2 minutes, and then the trap was removed and analyzed immediately by GC/MS.

VOST sampling traps were analyzed by thermal desorption GC/MS using procedures based on EPA Method 624. The step-by-step procedure is presented below:

1. Set GC/MS to analytical conditions.
2. Using 1/16-in. stainless steel lines, modify purge and trap apparatus to allow connection of a Tenax® trap before the water purging tube. The lines must be long enough to allow the trap to fit into a thermal desorption chamber, but kept as short as possible after the trap.
3. Heat thermal desorption chamber at 190°C.
4. Prepare a 10-µl syringe to inject internal standard by rinsing several times with high-purity methanol which has been previously screened for the components of interest.
5. Draw methanol into the syringe to the 1.0 µl mark. Draw internal standard to the 2.0 µl mark.
6. Remove end plugs from the Tenax trap and attach the trap to a GC injection port which is heated to 150°C. The trap must be situated so that the carrier gas flows through the Tenax trap in the same direction as used during sampling. The carrier is helium flowing at 50 ml/min.
7. Immediately inject the internal standard. Allow 180 sec for the standard to be flushed out of the injection port and onto the Tenax trap before removing the syringe.

8. Disconnect the Tenax trap from the injector and connect it to the modified purge lines of the purge and trap apparatus. The trap must be situated so that the sample is thermally desorbed with the carrier gas flowing opposite to the direction encountered during sampling and addition of the internal standard.
9. Set the purge and trap apparatus to PURGE and confirm that the analytical cartridge is at 25°C.
10. Make sure all fittings are leak tight and that the water purging tube is sealed and contains 5 ml of purged high-purity water.
11. Start the purge timer for a 11-min purge.
12. Slide the 190°C thermal desorption chamber around the Tenax trap and close the chamber lid.
13. While the sample is desorbing, cool the GC oven to 15°C and prepare the mass spectrometer data system as required.
14. At the end of the 15-min purge, turn the purge and trap apparatus to DESORB and immediately start the GC temperature program and MS data acquisition.
15. Repeat steps 11 through 14 with succeeding sets of Tenax and Tenax/charcoal traps.

Typical conditions used for the GC/MS analysis are presented in Table 19. The analytical procedure and instrument conditions are similar to those used in the volatile organic analysis procedures of Method 624. The GC/MS instrument was calibrated by spiking known concentrations of POHC's onto a Tenax trap. A multipoint calibration curve was initially established. Two-point checks of this calibration are made on a daily basis, and the internal standard, BFB, was monitored on each analysis. Not all halogenated organic compounds provide good linear response over a wide calibration range. For this reason, no analytical data outside of the calibration limits was reported. If necessary, the calibration range was extended to span the actual concentration.

TABLE 19. GC/MS ANALYTICAL CONDITIONS FOR VOST TENAX TRAPS --
SITES I AND K

Instrument:	Finnigan 4000 Gas Chromatograph/Mass Spectrometer or equivalent
Data System:	INCOS Data System or equivalent
Column:	0.2% Carbowax ^R 1500 on Carbopack ^R C, in a 2 mm ID x 6' stainless steel
Temperature Program:	15 ⁰ C to 190 ⁰ C at 10 ⁰ C/minute, hold for 15 minutes
Injection Type:	Tekmar ^R switching valve
Source Temperature:	250 ⁰ C
Injector Temperature:	190 ⁰ C
Scan Range:	Low Mass: 40 High Mass: 450 Scan Rate: 2 s/scan
Carrier Gas:	Helium at 30 mL/min

SECTION 3
ERROR ANALYSIS

When calculating DRE's, it is necessary to place error bands on the values in order to interpret the accuracy of the results. Sources of error in DRE's can be traced to the components of the POHC input and output flowrates. The criteria for the quantification of errors for DRE's is as follows:

<u>Error Source</u>	<u>Criteria for Quantifying Error Band</u>
a. Waste feedrate	• Range in measured flowrates, flow variability, over the period of the test (percent deviation) • Estimate in instrument error
b. POHC concentration in the waste	• Percent deviation from duplicate analyses (analytical precision) • Estimate of POHC stratification and period of occurrence • Percent recovery of standards and spikes (analytical accuracy)
c. Flue gas flowrate	• Accuracy of gas velocity measurements and stack gas stratification • Accuracy of organic sorbent sampling flowrates • Precision of stack measurements based on material balance evaluation
d. POHC concentration in the gas sample	• Percent recovery of standards and spikes (analytical accuracy)

- Estimation of percent sample breakthrough
- Compound concentration without subtracting blank values (worst case scenarios)

The main source of error in DRE's is generally associated with the POHC concentration in the gas sample.

The DRE can be expressed by the following equation:

$$DRE = 1 - \frac{P_{out}}{P_{in}} \quad (3-1)$$

where

P_{out} = Emission rate of pollutant

P_{in} = Pollutant feedrate

From error propagation principles, the uncertainty in P_{out} and P_{in} , $\Delta(P_{out})$ and $\Delta(P_{in})$ respectively, are approximated by:

$$\Delta(P_{out}) = (\dot{Q})(C_p) \left[\left(\frac{\Delta(C_p)}{C_p} \right)^2 + \left(\frac{\Delta(\dot{Q})}{\dot{Q}} \right)^2 \right]^{1/2} \quad (3-2)$$

$$\Delta(P_{in}) = (\dot{M})(C_F) \left[\left(\frac{\Delta(\dot{M})}{\dot{M}} \right)^2 + \left(\frac{\Delta(C_F)}{C_F} \right)^2 \right]^{1/2} \quad (3-3)$$

where

$\dot{Q}$ = Flue gas flowrate

C_p = Concentration of pollutant in the flue gas sample by laboratory analysis

$\dot{M}$ = Waste fuel feedrate

C_F = Concentration of pollutant in the waste fuel by laboratory analysis

and $\Delta(Q)$, $\Delta(C_p)$, $\Delta(\dot{M})$, and $\Delta(C_F)$ are their respective uncertainties

This can also be written as

$$\frac{\Delta(P_{out})}{(P_{out})} = U_o \quad (3-4)$$

$$\frac{\Delta(P_{in})}{(P_{in})} = U_i \quad (3-5)$$

where U_o and U_i are uncertainty factors for the output and input pollutant flowrates. The overall uncertainty factor, U , can be expressed as:

$$U = \sqrt{U_o^2 + U_i^2} \quad (3-6)$$

such that

$$\frac{\Delta\left(\frac{P_{out}}{P_{in}}\right)}{\left(\frac{P_{out}}{P_{in}}\right)} = U \quad (3-7)$$

where $\Delta\left(\frac{P_{out}}{P_{in}}\right)$ is the uncertainty in P_{out}/P_{in} .

Uncertainties in measuring emissions can be as large or larger than the actual measured values. This presents a problem when error propagation formulae are applied. However, if the error in one quantity (i.e. $\Delta C_p/C_p$) is much larger than all of the other errors, the overall errors calculated will still be valid. Table 20 presents the uncertainties in POHC input and output flowrates for each test site. The uncertainties in the input, U_i , are based on fluctuations in the waste fuel flow measurements and in the waste fuel composition. The composition of the waste fuel was not accurately known for site A and the percentage of water in the waste fuel for site B also had a large degree of uncertainty.

The uncertainty in the POHC output, U_o , is primarily due to the error in POHC concentration and breakthrough of volatile organics. Recovery efficiencies of surrogate and spiked samples were used to quantify the error in POHC concentration, $\Delta C_p/C_p$. The difference between the actual recovery and 100% recovery was divided by the actual recovery or 1.0, whichever gave the largest error. For example, if the fractional recovery of a compound was found to be .65, the error in POHC concentration, $\Delta C_p/C_p$, was taken as $35/65 = 0.54$. The range in recovery percentages are also shown in Table 20. The error is based on the worst case recoveries shown. The error due to

TABLE 20. ESTIMATE OF UNCERTAINTY FACTORS

Site	Input Errors			Output Errors				Percent Analytical Recovery for Output	Overall Uncertainty Factor U
	Flowrate $\dot{M}/\dot{M}$	POHC Composition $\Delta C_F/CF$	UI	Flowrate $\dot{Q}/\dot{Q}$	POHC Composition $\Delta C_P/C_P$	Volatile Organic Breakthrough Error	U ₀		
A	0.60	2.0	2.1	0.1	2.0	NA	33-130	2.0	2.9
B	0.72	0.4	0.82	0.1	1.2	NA	45-93 ^a	1.2	1.4
C	0.05	0.2	0.21	0.1	0.76	NA	57-80	0.76	0.8
D	0.19	0.2	0.28	0.1	2.0	0.8	33-250	2.0	2.2
E	0.10	0.2	0.22	0.1	1.5	1.0	40-156	1.8	1.8
F	0.10	0.2	0.22	0.1	1.1	0.8	60	1.4	1.4
G	0.10	0.2	0.22	0.1	1.0	0.13	49-93	1.0	1.0
H	0.10	0.2	0.22	0.1	0.7	0.23	60-120	0.7	0.8
I	0.05	0.2	0.21	0.1	1.0	NA	>45	1.0	1.0
J	0.15	0.1	0.18	0.1	1.1	NA	48-165	1.1	1.1
K	0.10	0.2	0.22	0.1	0.62	NA	62-116	0.62	0.65

^aA 3% recovery was obtained for toluene indicating an error factor of 32 and a worst case DRE of 97.7.

volatile organic breakthrough is determined from the relative amounts recovered from two traps in series.

We expect an error band in a DRE to be reflected by the same order of magnitude above and below the measured DRE as with a logarithmic distribution. Thus, the upper and lower bounds of a DRE are expressed as:

$$DRE_{min} = 1 - \frac{P_{out}}{P_{in}} (1 + U) \quad (3-8)$$

$$DRE_{max} = 1 - \frac{P_{out}}{P_{in}} \frac{1}{(1 + U)} \quad (3-9)$$

It is clear that DRE's are substantially affected (plus or minus "one 9") only if the uncertainty in $\frac{P_{out}}{P_{in}}$ is near an order of magnitude or greater.

Thus if $U + 1$ is less than 3, the value for a DRE should be conservatively accurate within "one 9". For a more conservative DRE, the compound concentration without subtracting blank values can be taken as a worst case scenario.

The uncertainty factors from Table 20 were applied to the mass weighted DRE's in Table 21 for the corresponding test sites to show the effect on the range in DRE's.

TABLE 21. UNCERTAINTIES IN DRE^a

Site	Uncertainty Factor	DRE _{min}	DRE _{max}	DRE
A	2.9	99.93478	99.99571	99.98328
B	1.4	99.97913	99.99638	99.99130
C	0.8	99.99888	99.99966	99.99938
D	2.2	99.99798	99.99980	99.99937
E	1.8	99.99318	99.99789	99.99621
F	1.4	99.97600	99.99583	99.99000
G	1.0	99.99972	99.99993	99.99986
H	0.8	99.98537	99.99548	99.99187
I	1.0	99.99898	99.99974	99.99949
J	1.1	99.99833	99.99963	99.99921
K	0.6	99.99988	99.99996	99.99993

^aDRE's are based on volatile and semivolatile RCRA Appendix VIII POHC's only. Appendix A of Volume I lists all organic compounds included in the site-specific mass average DRE.

SECTION 4
SUMMARY OF SAMPLING DATA

4.1	Site A
4.2	Site B
4.3	Site C
4.4	Site D
4.5	Site E
4.6	Site F
4.7	Site G
4.8	Site H
4.9	Site I
4.10	Site J
4.11	Site K

4.1 SITE A

TABLE 22. BOILER OPERATING CONDITIONS -- SITE A

Boiler Parameters	Cofired Tests (wood waste plus creosote sludge)
Wood waste feedrate, ^a kg/sec (lb/hr)	0.23 - 0.25 (1,750 - 2,020)
Creosote sludge feedrate g/sec (lb/hr)	54 (430)
Creosote/wood waste (percent heat input)	40
Total heat input MW (10 ⁶ Btu/hr)	5.0 - 5.7 (17.2 - 18.7)
Boiler efficiency (percent)	63
Bottom ash discharge rate, g/sec (lb/hr)	0.44 (3.5)
Flyash discharge rate, g/sec (lb/hr)	1.0 (8)
Flue gas discharge rate, ^b dscm/m (dscf/m)	157 - 168 (5,560 - 5,960)

^aDry basis^bCalculated from stack gas flowrate
measurements

4.2 SITE B

TABLE 23. FLOWRATE AND SAMPLING DATA -- SITE B

Test	1 Baseline	2 Cofiring	3 Cofiring	4 Cofiring
Natural Gas Flowrate, (m ³ /min) (scfm)	1.300 46.19	1.301 46.23	1.236 43.91	1.115 39.62
Heating Value, (kJ/m ³) (Btu/ft ³)	38,970 1,046	38,970 1,046	38,970 1,046	38,970 1,046
Wastewater Flowrate, (m ³ /hr) (gpm)	-- --	0.133 0.5877	0.123 0.5409	0.121 0.5307
Estimated Percent Water	--	28 ^a	99.9	99.7
Flue Gas Flowrate, (m ³ /sec) (dscfm)	0.34408 729.06	0.38535 816.5	0.37521 795.03	0.33664 713.29
Moisture in Flue Gas, (percent)	15.4	18.7	15.2	19.6
O ₂ , (percent dry)	4.9	5.3	5.7	5.0
Flue Gas Temperature, (°C) (°F)	164 328	160 320	159 319	158 316
Flue Gas Collected				
Tenax, (L) (scf)	1.87 0.066	1.94 0.0685	1.95 0.0689	1.94 0.0685
Modified Method 5, (m ³) (dscf)	7.62216 269.174	9.83014 347.148	9.81963 346.777	9.47533 334.618

^aBased upon waste analysis. Probably >99 percent water.

TABLE 24. BOILER OPERATING CONDITIONS -- SITE B

Test	1 Baseline	2 Cofire	3 Cofire	4 Cofire
Natural gas feedrate, (m ³ /min) (ft ³ /hr)	1.30 (2,770)	1.30 (2,770)	1.24 (2,630)	1.12 (2,380)
Steam pressure, (kPa) (psig)	630 (92)	510 (75)	540 (78)	570 (82)
Wastewater feedrate, (m ³ /hr) (gpm)	-- --	0.13 (0.59)	0.12 (0.54)	0.12 (0.53)
Atomizing air pressure, (kPa) (psi)	-- --	95 (14)	70 (10)	100 (15)
Wastewater fuel pressure, (kPa) (psi)	-- --	70 (10)	60 (8.6)	79 (11)

TABLE 25. INLET/OUTPUT H₂O FLOWRATE CALCULATIONS -- SITE B

	Units	Baseline Test 1	Test 2	Test 3	Test 4	Average Cofire
1) Natural gas flowrate	scfm lb/min	46.2 2.13	46.2 2.13	43.9 2.02	39.6 1.82	43.2 1.99
2) H ₂ O from natural gas H	lb/min	4.41	4.41	4.18	3.77	4.12
3) H ₂ O from combustion air	lb/min	0.43	0.47	0.46	0.41	0.45
4) Wastewater flowrate	gpm percent H ₂ O H ₂ O lb/min	0 0 0	0.588 27.9 1.37	0.541 99.9 4.5	0.531 99.7 4.41	0.553 75.8 3.43
5) H ₂ O from waste HC combustion	lb/min	0	1.7	0.23	0.70	0.88
6) Total calculated H ₂ O (2+3+4+5)	lb/min	4.84	7.95	9.37	9.29	8.87
7) Flue gas flowrate	dscfm lb/min percent H ₂ O	729 54.5 15.4	817 61.0 18.7	795 59.5 15.2	713 53.3 19.6	775 57.9 17.8
8) H ₂ O measured	lb/min	5.04	6.85	5.42	6.26	6.18
9) Out/In H ₂ O (8/6)	percent	104	86	58	67	70

4.3 SITE C

TABLE 26. FLOWRATE AND SAMPLING DATA -- SITE C

Test	1	2	3	4
	Baseline	Cofiring	Cofiring	Cofiring
Flue gas flowrate				
m ³ /s (dscfm)	13.00 (27,553)	13.38 (28,345)	13.13 (27,818)	13.06 (27,674)
Flue gas collected				
Modified method 5				
m ³ (ft ³)	8.039 (284.0)	7.963 (281.4)	7.766 (274.4)	7.866 (277.8)
Tenax train				
Liters (ft ³)	1.50 (0.053)	1.60 (0.057)	1.75 (0.062)	1.92, 2.10 (0.068, 0.074)
Moisture in flue gas, percent	12.2	11.0	9.8	10.8
O ₂ , percent dry	10	9.7	10.5	10.7
Waste flowrate				
ml/s (gph)	-- --	270 (256)	250 (238)	253 (241)

TABLE 27. BOILER OPERATING CONDITIONS -- SITE C

Boiler Parameters	Test 1 Baseline	Cofired Test		
		2	3	4
Steam flow, kg/s (1,000 lb/hr)	7.76 (61.5)	7.95 (63.0)	7.29 (57.8)	6.97 (55.3)
Natural gas flow, m ³ /s (1,000 scfh)	0.661 (84.0)	0.434 (55.2)	0.417 (53.0)	0.393 (49.9)
Waste fuel flow, ml/s (gph)	0	270 (256)	250 (238)	253 (241)
Waste heat input ^a , percent of total	0	38	37	39
Total heat input, ^a MW (million Btu/hr)	25.1 (85.7)	25.9 (88.3)	25.3 (86.2)	24.5 (83.4)
Gas pressure at burner, Pa (psig)	523 (2.10)	458 (1.84)	421 (1.69)	548 (2.20)
Forced draft fan outlet, Pa (in. H ₂ O)	57 (0.23)	67 (0.27)	80 (0.32)	82 (0.33)
Windbox pressure, Pa (in. H ₂ O)	300 (1.2)	300 (1.2)	-- NA	-- NA
Furnace pressure, Pa (in. H ₂ O)	-95 (0.38)	-95 (-0.38)	-87 (-0.35)	-90 (-0.36)
ID Fan inlet pressure, Pa (in. H ₂ O)	-324 (-1.3)	-274 (-1.1)	-274 (-1.1)	-274 (-1.1)
Stack opacity, percent	10	16	15	15

^aBased on 3.76 MJ/liter (135,000 Btu/gal) for the phenolic waste and 38.0 MJ/m³ (1,020 Btu/ft³) for natural gas

4.4 SITE D

TABLE 28. FLOWRATE AND SAMPLING DATA -- SITE D

Test No.	Baseline	Cofire with Solvent 3			Cofire with Solvent 6		
		2	3	4	5	6	7
Flue gas flowrate m ³ /s (10 ³ dscfm)	9.53 (20.19)	9.52 (20.16)	9.25 (19.59)	9.12 (19.32)	6.76 (14.33)	5.14 (10.9)	6.37 (13.49)
Flue gas collected • HCl train m ³ (dscf)	1.09 (38.5)	0.917 (32.4)	1.06 (37.5)	1.08 (38.2)	1.08 (38.0)	1.12 (39.5)	1.10 (39.0)
• Modified Method 5 m ³ (dscf)	8.01 (283)	9.68 (342)	9.23 (326)	8.92 (315)	6.74 (238)	5.15 (182)	6.51 (230)
• Tenax train liters (dscf)	6.0 (0.212)	6.0 (0.212)	6.0 (0.212)	6.0 (0.212)	6.0 (0.212)	6.0 (0.212)	6.0 (0.212)
Moisture in the flue gas, percent	9.89	9.45	8.86	11.1	8.46	8.06	8.11
Average stack O ₂ , percent dry	5.4	5.1	5.2	5.3	6.0	6.2	5.9
Average solvent flowrate m ³ /s (gpm)	--	264 (4.19)	274 (4.35)	257 (4.08)	187 (2.97)	192 (3.05)	185 (2.94)

TABLE 29. BOILER OPERATION DATA -- TEST 1
(BASELINE WITH NO. 6 OIL ONLY) -- SITE D

Parameter	Range	Average	Parameter	Range	Average
Steam flow, kg/s (10 ³ lb/hr)	8.7 to 9.1 (69 to 72)	8.8 (70)	No. 6 oil flow, kg/s (10 ³ lb/hr)	0.61 to 0.63 (4.83 to 4.96)	0.61 (4.86)
Drum pressure, MPa (psig)	1.52 to 1.55 (220 to 225)	1.54 (223)	Oil temperature, °C (°F)	104 to 107 (220 to 224)	106 (222)
Feedwater pressure, MPa (psig)	2.17 to 2.28 (315 to 330)	2.23 (323)	Oil burner pressure, MPa ^a (psig)	0.46 (66 to 67)	0.46 (66)
Air leaving preheater, °C (°F)	129 to 136 (265 to 276)	131 (268)	Atomizing steam pressure, MPa (psig)	0.88 to 0.90 (128 to 130)	0.89 (129)
Gas leaving preheater, °C (°F)	263 to 265 (505 to 509)	264 (507)	Air heater inlet pressure, kPa (in H ₂ O)	0.65 to 0.70 (2.6 to 2.8)	0.67 (2.7)
Gas entering preheater, °C (°F)	366 to 371 (690 to 700)	368 (695)	Furnace draft, kPa (in H ₂ O)	-0.02 to -0.05 (-0.1 to -0.2)	-0.04 (-0.15)
Air entering preheater, °C (°F)	--b	35 (95)	Boiler draft, kPa (in H ₂ O)	-0.40 to -0.44 (-1.6 to -1.75)	-0.42 (-1.7)

^aAll four burners firing no. 6 oil

^bNo discernable change over the duration of the test

TABLE 30. BOILER OPERATION DATA -- SITE D TESTS 2, 3, AND 4
(COFIRING WITH SOLVENT NO. 3)

Parameter	Test 2		Test 3		Test 4	
	Range	Average	Range	Average	Range	Average
Steam flow, kg/s (10 ³ lb/hr)	8.8 to 9.1 (70 to 72)	9.0 (71)	8.3 to 9.1 (66 to 72)	8.6 (68)	8.8 to 9.1 (70 to 72)	9.0 (71)
Drum pressure, MPa (psig)	--a	1.55 (225)	1.52 to 1.55 (220 to 225)	1.52 (221)	--a	1.52 (220)
Feedwater pressure, MPa (psig)	2.21 to 2.28 (320 to 330)	2.24 (325)	2.17 to 2.24 (315 to 325)	2.21 (320)	2.14 to 2.17 (310 to 315)	2.15 (312)
Air leaving preheater, °C (°F)	127 to 132 (260 to 270)	129 (265)	127 to 129 (260 to 265)	128 (262)	124 to 125 (255 to 257)	125 (257)
Gas leaving preheater, °C (°F)	268 to 274 (515 to 525)	271 (519)	254 to 260 (490 to 500)	259 (498)	257 to 266 (495 to 510)	263 (505)
Gas entering preheater, °C (°F)	377 to 382 (710 to 720)	379 (715)	363 to 367 (685 to 692)	366 (690)	366 to 371 (690 to 700)	370 (698)
Air entering preheater, °C (°F)	--a	35 (95)	--a	35 (95)	--a	32 (90)
Air heater inlet, kPa (in H ₂ O)	0.67 to 0.75 (2.7 to 3.0)	0.72 (2.9)	0.62 to 0.67 (2.5 to 2.7)	0.65 (2.6)	0.67 to 0.70 (2.7 to 2.8)	0.70 (2.8)
Furnace draft, kPa (in H ₂ O)	-0.02 to -0.06 (-0.10 to -0.25)	-0.04 (-0.16)	-0.02 to -0.04 (-0.10 to -0.18)	-0.04 (-0.15)	-0.01 to -0.06 (-0.05 to -0.25)	-0.04 (-0.15)
Boiler draft, kPa (in H ₂ O)	-0.42 to -0.47 (-1.7 to -1.9)	-0.45 (-1.8)	-0.65 to -0.70 (-2.6 to -2.8)	-0.67 (-2.7)	-0.40 to -0.45 (-1.6 to -1.8)	-0.45 (-1.8)
No. 6 oil flow, kg/s (10 ³ lb/hr)	0.448 to 0.462 (3.55 to 3.66)	0.54 (3.60)	0.42 to 0.449 (3.33 to 3.56)	0.435 (3.45)	0.483 to 0.494 (3.83 to 3.92)	0.489 (3.88)
Oil temperature, °C (°F)	104 to 108 (220 to 226)	105 (222)	104 to 105 (220 to 222)	105 (222)	--a	107 (225)
Oil burner pressure, MPa (psig)	NAb	NAb	NAb	NAb	--a	0.61 (88)
Atomizing steam pressure, MPa (psig)	NAb	NAb	--a	0.77 (112)	--a	1.03 (150)
No. of burners on oil	--a	3	--a	3	--a	3
Waste solvent flow, ml/s (gpm)	249 to 273 (3.95 to 4.32)	263 (4.17)	245 to 295 (3.89 to 4.68)	273 (4.33)	245 to 266 (3.88 to 4.21)	255 (4.04)
Solvent burner pressure, MPa (psig)	0.30 to 0.34 (43 to 49)	0.32 (46)	0.31 to 0.35 (45 to 51)	0.32 (47)	0.30 to 0.34 (43 to 50)	0.32 (46)
Atomizing steam pressure, MPa (psig)	0.34 to 0.48 (50 to 70)	0.39 (57)	0.40 to 0.44 (58 to 64)	0.41 (60)	0.46 to 0.52 (67 to 75)	0.48 (69)
Boiler out O ₂ , percent	3.1 to 3.8	3.5	3.6 to 4.5	4.2	3.6 to 4.2	4.0

*No discernable change over the duration of the test
DNA -- Not available

TABLE 31. BOILER OPERATION DATA -- SITE D TESTS 5, 6, AND 7
(COFIRING WITH SOLVENT NO. 6)

Parameter	Test 5		Test 6		Test 7	
	Range	Average	Range	Average	Range	Average
Steam flow, kg/s (10 ³ lb/hr)	5.7 to 5.8 (45 to 46)	5.8 (46)	5.5 to 5.7 (44 to 45)	5.7 (45)	5.5 to 5.7 (44 to 45)	5.5 (44)
Drum pressure, MPa (psig)	--a	1.48 (215)	--a	1.48 (215)	--a	1.48 (215)
Feedwater pressure, MPa (psig)	2.07 to 2.14 (300 to 310)	2.11 (306)	2.21 to 2.25 (320 to 326)	2.23 (323)	2.22 to 2.24 (322 to 325)	2.23 (324)
Air leaving preheater, °C (°F)	116 to 117 (240 to 242)	117 (242)	--a	118 (245)	114 to 118 (237 to 245)	116 (241)
Gas leaving preheater, °C (°F)	204 to 207 (400 to 405)	207 (404)	202 to 210 (395 to 410)	204 (400)	202 to 208 (395 to 407)	206 (402)
Gas entering preheater, °C (°F)	300 to 302 (572 to 575)	301 (574)	296 to 307 (565 to 585)	301 (573)	296 to 302 (565 to 576)	301 (573)
Air entering preheater, °C (°F)	--a	29 (85)	--a	35 (95)	--a	35 (85)
Air heater inlet, kPa (in H ₂ O)	0.31 to 0.32 (1.25 to 1.3)	0.32 (1.3)	0.32 to 0.35 (1.3 to 1.4)	0.34 (1.35)	0.30 to 0.32 (1.2 to 1.3)	0.31 (1.25)
Furnace draft, kPa (in H ₂ O)	-0.03 to -0.04 (-0.14 to -0.17)	-0.03 (-0.15)	-0.03 to -0.04 (-0.14 to -0.17)	-0.03 (-0.15)	-0.03 to -0.04 (-0.14 to -0.17)	-0.03 (-0.15)
Boiler draft, kPa (in H ₂ O)	-0.20 to -0.21 (-0.80 to -0.85)	-0.21 (-0.83)	-0.25 to -0.30 (-1.0 to -1.2)	-0.27 (-1.1)	-0.20 to -0.21 (-0.82 to -0.85)	-0.21 (-0.84)
No. 6 oil flow, kg/s (10 ³ lb/hr)	0.177 to 0.183 (1.40 to 1.45)	0.180 (1.43)	0.174 to 0.179 (1.38 to 1.42)	0.178 (1.41)	0.169 to 0.177 (1.34 to 1.40)	0.172 (1.36)
Oil temperature, °C (°F)	--a	107 (224)	--a	107 (223)	--a	107 (224)
Oil burner pressure, MPa (psig)	--a	0.30 (44)	0.29 to 0.30 (42 to 44)	0.30 (44)	--a	0.32 (46)
Atomizing steam pressure, MPa (psig)	--a	0.73 (106)	0.71 to 0.73 (103 to 106)	0.72 (104)	--a	0.74 (108)
No. of burners on oil	--a	2	--a	2	--a	2
Waste solvent flow, ml/s (gpm)	180 to 192 (2.86 to 3.05)	187 (2.97)	182 to 192 (2.89 to 3.04)	187 (2.97)	184 to 199 (2.91 to 3.16)	192 (3.04)
Solvent burner pressure, MPa (psig)	0.18 to 0.19 (26 to 27)	0.19 (26.6)	0.17 to 0.18 (24 to 26)	0.17 (25)	0.20 to 0.21 (29 to 31)	0.21 (30)
Atomizing steam pressure, MPa (psig)	0.34 to 0.39 (50 to 56)	0.37 (54)	0.34 to 0.39 (50 to 57)	0.37 (54)	0.34 to 0.37 (49 to 54)	0.37 (53)
Boiler out O ₂ , percent	3.5 to 4.1	3.8	4.0 to 4.9	4.4	4.9 to 5.2	5.0

^aNo discernable change over the duration of the test

TABLE 32. BOILER HEAT INPUT AND OUTPUT -- SITE D

	Baseline Test 1	No. 6 Oil and Solvent Stream No. 3			No. 6 Oil and Solvent Stream No. 6		
		Test 2	Test 3	Test 4	Test 5	Test 6	Test 7
Total heat input, MW (10 ⁶ Btu/hr)	25.2 (86.0)	27.8 (94.9)	26.5 (90.5)	25.8 (88.0)	14.9 (50.9)	14.3 (48.7)	14.3 (48.9)
Heat from no. 6 oil, percent	100	70.0	70.7	81.7	52.1	53.7	51.6
Heat from waste solvent, percent	0	30.0	29.3	18.3	47.9	46.3	48.4
Total boiler heat output, MW (10 ⁶ Btu/hr)	20.5 (70.0)	20.8 (71.0)	19.9 (68.0)	20.8 (71.0)	13.5 (46.0)	13.2 (45.0)	12.9 (44.0)
Boiler thermal efficiency, percent ^a	81.3	74.8	75.1	80.6	90.6	92.3	90.2

^aFrom heat output and input data

4.5 SITE E

TABLE 34. BOILER OPERATING SUMMARY -- SITE E

Primary and Waste Fuels	No. 6 oil (Baseline)	No. 6 Oil and TSB	No. 6 Oil and Chlorinated TSB					Natural Gas and Chlorinated TSB	Natural Gas and Toluene MMA Mix
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9
Steam flow, kg/s (10 ³ lb/hr)	6.8 (54)	7.0 (56)	7.0 (56)	7.0 (56)	6.9 (55)	5.1 (41)	10.2 (81)	7.2 (57)	5.5 (44)
No. 6 oil flow, ml/s (gpm)	515 (8.18)	448 (7.12)	352 (5.59)	375 (5.95)	358 (5.68)	214 (3.40)	616 (9.79)	0	0
Natural gas flow, l/s (10 ³ cfm)	0	0	0	0	0	0	0	354 (45.0)	204 (26.0)
Waste fuel flow, ml/s (gpm)	0	195 (3.10)	236 (3.75)	260 (4.13)	250 (3.97)	261 (4.15)	249 (3.96)	259 (4.11)	235 (3.74)
Total heat input, MW (million Btu/hr)	21.8 (74.2)	24.0 (82.0)	20.6 (70.4)	22.3 (76.0)	21.0 (71.6)	15.6 (53.2)	32.3 (110)	19.7 (67.1)	15.9 (54.3)
Waste fuel heat input (percent of total)	0	(21)	(28)	(29)	(28)	(42)	(19)	(33)	(52)
Boiler out O ₂ (percent dry)	(3.0)	(3.9)	(4.4)	(6.0)	(5.9)	(4.9)	(6.0)	(4.6)	(5.3)
Number of smoke emission episodes ^a	0	1	8	4	3	0	3 ^b	0 ^c	0 ^c

^aNumber of recorded smoke alarms. Ringelman number >0.6 during smoke alarm based on CO emission response. Plant smoke meter was inoperable during this high load test 8 visible plume but no smoke alarm took place during these tests.

TABLE 35. BOILER DESIGN AND OPERATING CHARACTERISTICS -- SITE E

Steam Load, kg/s (lb/hr)	13.9 (110,000)	10.4 (82,500)	6.94 (55,000)	3.47 (27,500)
Superheater outlet pressure, MPa (psig)	2.94 (425)	2.94 (425)	2.94 (425)	2.94 (425)
Superheater outlet temperature, °C (°F)	316 (500)	321 (610)	319 (607)	304 (580)
Feedwater temperature, °C (°F)	113 (235)	113 (235)	113 (235)	113 (235)
No. 6 oil firing rate ^a , kg/s (lb/hr)	0.933 (7,400)	0.706 (5,600)	0.468 (3,710)	0.231 (1,830)
Surface heat release rate, kW/m ² (Btu/hr-ft ²)	396 (125,000)	317 (100,000)	238 (75,000)	158 (50,000)
Combustion excess air, percent	15	15	15	15
Boiler thermal efficiency, percent	88.1	88.3	88.5	88.1
Gas throughput, kg/s (lb/hr)	15.83 (125,500)	11.85 (94,000)	7.88 (62,500)	3.87 (30,700)
Flame front temperature, °C (°F)	1,980 (3,600)	1980 (3,500)	1,980 (3,600)	1,980 (3,600)
Average furnace temperature, °C (°F)	1,590 (2,900)	1,565 (2,850)	1530 (2,790)	1,480 (2,700)
Minimum furnace outlet temperature, °C (°F)	1,200 (2,200)	1,150 (2,100)	1,080 (1,980)	980 (1,800)
Economizer gas inlet temperature, °C (°F)	363 (685)	323 (615)	290 (555)	263 (505)
Economizer gas outlet temperature, °C (°F)	166 (330)	146 (295)	135 (275)	124 (255)
Furnace gas residence time, sec	0.38	0.48	0.65	1.0

^aBased on no. 6 oil high heating value of 43,000 kJ/kg (18,500 Btu/lb)

TABLE 36. BOILER HEAT INPUT AND OUTPUT -- SITE E

	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9
Heat input (million Btu/hr):									
Fuel oil	72.3	62.9	49.4	52.6	50.2	30.1	86.6	0	0
Natural gas	0	0	0	0	0	0	0	47.1	26.0
Waste fuel	0	17.6	19.5	20.9	19.8	22.4	20.6	23.0	32.6
Total heat input (million Btu/hr)	72.3	80.5	68.9	73.5	70.0	52.4	107.0	70.1	58.6
Total heat output (million Btu/hr)	63.9	64.7	61.4	64.7	62.6	49.4	91.5	67.9	52.1
Boiler efficiency ^a (percent)	88.4	80.4	89.1	88.0	89.4	94.1	85.5	96.9	88.9

^aFrom heat input/output data

TABLE 37. BOILER OPERATION DATA -- SITE E TEST 1
(BASELINE, NO. 6 FUEL ONLY)

Parameter	Units	Range		Test Average	
Steam flow	kg/s (10 ³ lb/hr)	6.68 to 7.19	(53 to 57)	6.81	(54)
Steam pressure	MPa (psig)	2.79 to 2.86	(406 to 416)	2.83	(411)
Steam temperature	°C (°F)	296 to 300	(565 to 573)	2.98	(569)
Feedwater flow	kg/s (10 ³ lb/hr)	7.18 to 7.82	(57 to 62)	7.44	(59)
Feedwater temperature	°C (°F)	112 to 113	(233 to 235)	112	(234)
Economizer water out temperature	°C (°F)	172 to 178	(342 to 352)	175	(347)
Gas temperature, boiler out	°C (°F)	349 to 355	(661 to 672)	351	(664)
Gas temperature, economizer out	°C (°F)	156 to 160	(313 to 320)	158	(317)
Fan discharge pressure	kPa (in. H ₂ O)	1.03 to 1.11	(4.2 to 4.5)	1.08	(4.4)
Windbox pressure	kPa (in. H ₂ O)	--	--	0.86	(3.5)
Furnace pressure	kPa (in. H ₂ O)	0.34 to 0.42	(1.4 to 1.7)	0.37	(1.5)
Economizer out pressure	kPa (in. H ₂ O)	--	--	-0.07	(-0.3)
Oil flow ^a	ml/s (gpm)	4.71 to 4.82	(7.48 to 7.65)	475	(7.55)
Oil flow ^b	ml/s (gpm)	504 to 528	(8.00 to 8.38)	515	(8.18)
Oil temperature	°C (°F)	64	(147 to 148)	64	(148)
Oil burner pressure	MPa (psig)	0.54 to 0.55	(78 to 80)	0.54	(79)
Oil atomization steam pressure	MPa (psig)	0.69 to 0.70	(100 to 102)	0.69	(101)
Waste fuel flow ^a	ml/s (gpm)	0	0	0	0
Waste fuel flow ^b	ml/s (gpm)	0	0	0	0
Waste fuel flow ^c	ml/s (gpm)	0	0	0	0
Waste fuel supply pressure	kPa (psig)	69 to 76	(10 to 11)	70	(10)
Waste fuel burner pressure	kPa (psig)	0	0	0	0
Waste atomization steam pressure	kPa (psig)	165	(24)	165	(24)
Boiler out O ₂	percent	2.93 to 3.55	(2.93 to 3.55)	3.03	3.03
Kjeldahl smoke number	--	0	0	0	0

^aFuel flow readouts from microprocessor for both oil and waste fuels

^bFuel flows calculated from totalizer readout of total gallons burned for both oil and waste fuels. These flows were considered as most representative.

^cWaste fuel flow readout from Hersey meter

-- Indicates that no discernible change took place over duration of test

TABLE 38. BOILER OPERATION DATA -- SITE E TEST 2
(NO. 6 OIL AND TSB WASTE FUEL)

Parameter	Units	Range		Test Average	
Steam flow	kg/s (10 ³ lb/hr)	6.68 to 7.31	(53 to 58)	7.0	(55.5)
Steam pressure	MPa (psig)	2.82 to 2.89	(410 to 420)	2.85	(4.5)
Steam temperature	°C (°F)	295 to 298	(563 to 568)	296	(565.5)
Feedwater flow	kg/s (10 ³ lb/hr)	7.18 to 7.82	(56 to 63)	7.5	(59.5)
Feedwater temperature	°C (°F)	111 to 112	(232 to 233)	111	(232.5)
Economizer water out temperature	°C (°F)	173 to 187	(343 to 368)	180	(355.5)
Gas temperature, boiler out	°C (°F)	342 to 363	(647 to 685)	352	(666)
Gas temperature, economizer out	°C (°F)	153 to 167	(308 to 333)	160	(320.5)
Fan discharge pressure	kPa (in. H ₂ O)	1.23 to 1.52	(5.0 to 6.2)	1.38	(5.6)
Windbox pressure	kPa (in. H ₂ O)	0.71 to 1.01	(2.9 to 4.1)	0.86	(3.5)
Furnace pressure	kPa (in. H ₂ O)	2.20 to 3.03	(1.3 to 2.1)	2.45	(1.7)
Economizer out pressure	kPa (in. H ₂ O)	--	--	-0.43	(-0.3)
Oil flow ^a	ml/s (gpm)	397 to 485	(6.3 to 7.7)	441	(7.0)
Oil flow ^b	ml/s (gpm)	423 to 473	(6.72 to 7.52)	448	(7.12)
Oil temperature	°C (°F)	63 to 64	(145 to 147)	63	(146)
Oil burner pressure	MPa (psig)	0.51 to 0.56	(74 to 82)	0.54	(78)
Oil atomization steam pressure	MPa (psig)	0.66 to 0.70	(96 to 102)	0.68	(99)
Waste fuel flow ^a	ml/s (gpm)	190 to 231	(3.02 to 3.67)	210	(3.34)
Waste fuel flow ^b	ml/s (gpm)	--	--	--	--
Waste fuel flow ^c	ml/s (gpm)	189 to 201	(3.0 to 3.2)	195	(3.1)
Waste fuel supply pressure	kPa (psig)	950 to 964	(138 to 140)	957	(139)
Waste fuel burner pressure	kPa (psig)	440 to 454	(64 to 66)	447	(65)
Waste atomization steam pressure	kPa (psig)	661 to 675	(96 to 98)	668	(97)
Boiler out O ₂	percent	2.89 to 4.9	(2.89 to 4.9)	3.89	(3.89)
Ringelman smoke number	--		(0 to 0.2)		(0.1)

^aFuel flow readouts from microprocessor for both oil and waste fuels

^bFuel flows calculated from totalizer readout of total gallons burned for both oil and waste fuels. Readings for waste fuel were not available for this test.

^cWaste fuel flow readout from Hersey meter

-- Indicates that no discernible change took place over duration of test

TABLE 39. BOILER OPERATION DATA -- SITE E TEST 3
(NO. 6 OIL AND CHLORINATED TSB WASTE FUEL)

Parameter	Units	Range		Test Average	
Steam flow	kg/s (10 ³ lb/hr)	6.68 to 7.31	(53 to 58)	7.0	(55.5)
Steam pressure	MPa (psig)	2.85 to 2.90	(415 to 422)	2.88	(418.5)
Steam temperature	°C (°F)	287 to 295	(549 to 564)	291	(556)
Feedwater flow	kg/s (10 ³ lb/hr)	6.93 to 8.07	(55 to 64)	7.50	(59.5)
Feedwater temperature	°C (°F)	111 to 112	(232 to 234)	111	(233)
Economizer water out temperature	°C (°F)	168 to 188	(334 to 370)	178	(352)
Gas temperature, boiler out	°C (°F)	347 to 375	(657 to 708)	361	(682.5)
Gas temperature, economizer out	°C (°F)	156 to 170	(313 to 339)	163	(326)
Fan discharge pressure	kPa (in. H ₂ O)	1.77 to 2.16	(7.2 to 8.8)	1.97	(8.0)
Windbox pressure	kPa (in. H ₂ O)	0.69 to 0.91	(2.8 to 3.7)	0.80	(3.25)
Furnace pressure	kPa (in. H ₂ O)	0.37 to 0.56	(1.5 to 2.3)	0.47	(1.9)
Economizer out pressure	kPa (in. H ₂ O)	-0.07 to -0.10	(-0.3 to -0.4)	-0.09	(-0.35)
Oil flow ^a	ml/s (gpm)	340 to 353	(5.4 to 5.61)	346	(5.5)
Oil flow ^b	ml/s (gpm)	327 to 378	(5.19 to 6.0)	352	(5.59)
Oil temperature	°C (°F)	63	(145)	63	(145)
Oil burner pressure	MPa (psig)	0.47 to 0.49	(68 to 71)	0.48	(69.5)
Oil atomization steam pressure	MPa (psig)	0.62 to 0.64	(90 to 93)	0.63	(91.5)
Waste fuel flow ^a	ml/s (gpm)	179 to 275	(2.85 to 4.37)	227	(3.61)
Waste fuel flow ^b	ml/s (gpm)	210 to 263	(3.33 to 4.18)	236	(3.75)
Waste fuel flow ^c	ml/s (gpm)	176 to 258	(2.8 to 4.1)	217	(3.45)
Waste fuel supply pressure	kPa (psig)	840 to 950	(122 to 138)	895	(130)
Waste fuel burner pressure	kPa (psig)	330 to 427	(48 to 62)	379	(55)
Waste atomization steam pressure	kPa (psig)	633 to 675	(92 to 98)	654	(95)
Boiler out O ₂	percent	3.13 to 5.71	(3.13 to 5.71)	4.42	(4.42)
Ringelman smoke number	--		0 to 0.4		(0.2)

^aFuel flow readouts from microprocessor for both oil and waste fuels

^bFuel flows calculated from totalizer readout of total gallons burned for both oil and waste fuels. These flows were considered as most representative.

^cWaste fuel flow readout from Hersey meter

-- Indicates that no discernible change took place over duration of test

TABLE 40. BOILER OPERATION DATA -- SITE E TEST 4
(NO. 6 OIL AND CHLORINATED TSB WASTE FUEL)

Parameter	Units	Range		Test Average	
Steam flow	kg/s (10 ³ lb/hr)	6.93 to 7.06	(55 to 56)	7.0	(55.5)
Steam pressure	MPa (psig)	2.85 to 2.90	(415 to 421)	2.87	(418)
Steam temperature	°C (°F)	288 to 290	(550 to 555)	289	(552.5)
Feedwater flow	kg/s (10 ³ lb/hr)	7.31 to 7.82	(58 to 62)	7.57	(60)
Feedwater temperature	°C (°F)	110 to 111	(230 to 232)	110	(231)
Economizer water out temperature	°C (°F)	188 to 193	(370 to 380)	190	(375)
Gas temperature, boiler out	°C (°F)	371 to 382	(700 to 720)	377	(710)
Gas temperature, economizer out	°C (°F)	174 to 179	(345 to 355)	177	(350)
Fan discharge pressure	kPa (in. H ₂ O)	2.21 to 2.46	(9-10)	2.34	(9.5)
Windbox pressure	kPa (in. H ₂ O)	0.98 to 1.11	(4.0 to 4.5)	1.04	(4.25)
Furnace pressure	kPa (in. H ₂ O)	0.64 to 0.74	(2.6 to 3.0)	0.69	(2.8)
Economizer out pressure	kPa (in. H ₂ O)	--	--	-0.07	(-0.3)
Oil flow ^a	ml/s (gpm)	356 to 369	(5.65 to 5.87)	363	(5.76)
Oil flow ^b	ml/s (gpm)	363 to 387	(5.76 to 6.15)	375	(5.95)
Oil temperature	°C (°F)	--	--	64	(148)
Oil burner pressure	MPa (psig)	0.43 to 0.47	(63 to 68)	0.45	(65.5)
Oil atomization steam pressure	MPa (psig)	0.60 to 0.63	(88 to 92)	0.62	(90)
Waste fuel flow ^a	ml/s (gpm)	209 to 249	(3.32 to 3.96)	229	(3.64)
Waste fuel flow ^b	ml/s (gpm)	252 to 268	(4.0 to 4.26)	260	(4.13)
Waste fuel flow ^c	ml/s (gpm)	214 to 252	(3.4 to 4.0)	233	(3.7)
Waste fuel supply pressure	kPa (psig)	578 to 730	(84 to 106)	654	(95)
Waste fuel burner pressure	kPa (psig)	688 to 695	(100 to 101)	692	(100.5)
Waste atomization steam pressure	kPa (psig)	558 to 675	(81 to 98)	616	(89.5)
Boiler out O ₂	percent	5.72 to 6.3	(5.72 to 6.3)	6.01	(6.01)
Ringelman smoke number	--	--	(0.1 to 0.2)	--	(0.15)

^aFuel flow readouts from microprocessor for both oil and waste fuels

^bFuel flows calculated from totalizer readout of total gallons burned for both oil and waste fuels. These flows were considered as most representative.

^cWaste fuel flow readout from Hersey meter

-- Indicates that no discernible change took place over duration of test

TABLE 41. BOILER OPERATION DATA -- SITE E TEST 5
(NO. 6 OIL AND CHLORINATED TSB WASTE FUEL)

Parameter	Units	Range		Test Average	
Steam flow	kg/s (10 ³ lb/hr)	6.75 to 7.12	(53.5 to 56.5)	6.93	(55)
Steam pressure	MPa (psig)	2.82 to 2.85	(410 to 415)	2.84	(412.5)
Steam temperature	°C (°F)	288 to 290	(550 to 555)	289	(552.5)
Feedwater flow	kg/s (10 ³ lb/hr)	7.06 to 7.57	(56 to 60)	7.31	(58)
Feedwater temperature	°C (°F)	--	--	111	(232)
Economizer water out temperature	°C (°F)	185 to 189	(365 to 372)	187	(368.5)
Gas temperature, boiler out	°C (°F)	360 to 365	(680 to 690)	363	(685)
Gas temperature, economizer out	°C (°F)	168 to 171	(335 to 340)	170	(337.5)
Fan discharge pressure	kPa (in. H ₂ O)	2.34 to 2.51	(9.5 to 10.2)	2.42	(9.85)
Windbox pressure	kPa (in. H ₂ O)	--	--	0.98	(4.0)
Furnace pressure	kPa (in. H ₂ O)	0.58 to 0.61	(2.35 to 2.5)	0.59	(2.42)
Economizer out pressure	kPa (in. H ₂ O)	-0.06 to -0.09	(-0.25 to -0.38)	-0.08	(-0.31)
Oil flow ^a	ml/s (gpm)	335 to 358	(5.33 to 5.68)	346	(5.50)
Oil flow ^b	ml/s (gpm)	342 to 373	(5.43 to 5.93)	358	(5.68)
Oil temperature	°C (°F)	--	--	64	(148)
Oil burner pressure	MPa (psig)	0.40 to 0.43	(58 to 62)	0.41	(60)
Oil atomization steam pressure	MPa (psig)	0.57 to 0.60	(83 to 88)	0.59	(85.5)
Waste fuel flow ^a	ml/s (gpm)	218 to 249	(3.47 to 3.95)	233	(3.71)
Waste fuel flow ^b	ml/s (gpm)	242 to 259	(3.84 to 4.11)	250	(3.97)
Waste fuel flow ^c	ml/s (gpm)	227 to 264	(3.6 to 4.2)	245	(3.9)
Waste fuel supply pressure	kPa (psig)	523 to 750	(76 to 109)	637	(92.5)
Waste fuel burner pressure	kPa (psig)	688 to 695	(100 to 101)	692	(100.5)
Waste atomization steam pressure	kPa (psig)	585 to 668	(85 to 97)	626	(91)
Boiler out O ₂	percent	5.44 to 6.37	(5.44 to 6.37)	5.90	(5.90)
Ringelman smoke number	--	--	(0.05 to 0.2)	--	(0.12)

^aFuel flow readouts from microprocessor for both oil and waste fuels

^bFuel flows calculated from totalizer readout of total gallons burned for both oil and waste fuels. These flows were considered as most representative.

^cWaste fuel flow readout from Hersey meter

-- Indicates that no discernible change took place over duration of test

TABLE 42. BOILER OPERATION DATA -- SITE E TEST 6
(NO. 6 OIL AND CHLORINATED TSB WASTE FUEL)

Parameter	Units	Range		Test Average	
Steam flow	kg/s (10 ³ lb/hr)	4.97 to 5.30	(39 to 42)	5.11	(40.5)
Steam pressure	MPa (psig)	2.79 to 2.88	(405 to 419)	2.83	(412)
Steam temperature	°C (°F)	293 to 6.05	(560 to 568)	295	(564)
Feedwater flow	kg/s (10 ³ lb/hr)	5.42 to 6.05	(43 to 48)	5.74	(45.5)
Feedwater temperature	°C (°F)	--	--	111	(232)
Economizer water out temperature	°C (°F)	174 to 177	(345 to 350)	175	(347.5)
Gas temperature, boiler out	°C (°F)	317 to 321	(602 to 610)	319	(606)
Gas temperature, economizer out	°C (°F)	146 to 149	(295 to 300)	148	(297.5)
Fan discharge pressure	kPa (in. H ₂ O)	--	--	2.7	(11)
Windbox pressure	kPa (in. H ₂ O)	0.49 to 0.93	(2.0 to 3.8)	0.71	(2.9)
Furnace pressure	kPa (in. H ₂ O)	0.17 to 0.18	(0.7 to 0.75)	0.18	(0.725)
Economizer out pressure	kPa (in. H ₂ O)	-0.06 to -0.09	(-0.25 to -0.40)	-0.08	(-0.325)
Oil flow ^a	ml/s (gpm)	242 to 246	(3.85 to 3.91)	244	(3.88)
Oil flow ^b	ml/s (gpm)	211 to 218	(3.35 to 3.46)	214	(3.40)
Oil temperature	°C (°F)	64	(147 to 148)	64	(147.5)
Oil burner pressure	MPa (psig)	--	--	0.29	(43)
Oil atomization steam pressure	MPa (psig)	--	--	0.45	(66)
Waste fuel flow ^a	ml/s (gpm)	228 to 267	(3.63 to 4.24)	247	(3.93)
Waste fuel flow ^b	ml/s (gpm)	243 to 279	(3.86 to 4.44)	261	(4.15)
Waste fuel flow ^c	ml/s (gpm)	245 to 283	(3.9 to 4.5)	264	(4.2)
Waste fuel supply pressure	kPa (psig)	792 to 854	(115 to 124)	823	(119.5)
Waste fuel burner pressure	kPa (psig)	--	--	695	(101)
Waste atomization steam pressure	kPa (psig)	654 to 675	(95 to 98)	664	(96.5)
Boiler out O ₂	percent	4.14 to 5.71	(4.14 to 5.71)	4.92	(4.92)
Ringelman smoke number	--	--	--	--	(0)

^aFuel flow readouts from microprocessor for both oil and waste fuels

^bFuel flows calculated from totalizer readout of total gallons burned for both oil and waste fuels. These flows were considered as most representative.

^cWaste fuel flow readout from Hersey meter

-- Indicates that no discernible change took place over duration of test

TABLE 43. BOILER OPERATION DATA -- SITE E TEST 7
(NO. 6 OIL AND CHLORINATED TSB WASTE FUEL)

Parameter	Units	Range		Test Average	
Steam flow	kg/s (10 ³ lb/hr)	9.96 to 10.34	(79 to 82)	10.15	(80.5)
Steam pressure	MPa (psig)	2.90 to 3.03	(421 to 440)	2.96	(430.5)
Steam temperature	°C (°F)	285 to 288	(545 to 550)	286	(547.5)
Feedwater flow	kg/s (10 ³ lb/hr)	10.5 to 11.0	(83 to 87)	10.7	(85)
Feedwater temperature	°C (°F)	--	--	111	(232)
Economizer water out temperature	°C (°F)	196 to 199	(385 to 390)	198	(387.5)
Gas temperature, boiler out	°C (°F)	415 to 429	(780 to 805)	422	(792.5)
Gas temperature, economizer out	°C (°F)	204 to 208	(400 to 407)	206	(403.5)
Fan discharge pressure	kPa (in. H ₂ O)	2.09 to 2.21	(8.5 to 9.0)	2.15	(8.75)
Windbox pressure	kPa (in. H ₂ O)	1.72 to 1.82	(7.0 to 7.4)	1.77	(7.2)
Furnace pressure	kPa (in. H ₂ O)	1.55 to 1.65	(6.3 to 6.7)	1.60	(6.5)
Economizer out pressure	kPa (in. H ₂ O)	-0.02 to -0.05	(-0.1 to -0.2)	-0.04	(-0.15)
Oil flow ^a	ml/s (gpm)	582 to 587	(9.25 to 9.32)	584	(9.28)
Oil flow ^b	ml/s (gpm)	611 to 622	(9.71 to 9.88)	616	(9.79)
Oil temperature	°C (°F)	64 to 65	(148 to 149)	65	(148.5)
Oil burner pressure	MPa (psig)	0.63 to 0.64	(92 to 93)	0.64	(92.5)
Oil atomization steam pressure	MPa (psig)	0.73 to 0.74	(106 to 107)	0.73	(106.5)
Waste fuel flow ^a	ml/s (gpm)	214 to 253	(3.4 to 4.02)	233	(3.71)
Waste fuel flow ^b	ml/s (gpm)	231 to 268	(3.67 to 4.26)	249	(3.96)
Waste fuel flow ^c	ml/s (gpm)	214 to 264	(3.4 to 4.2)	239	(3.8)
Waste fuel supply pressure	kPa (psig)	743 to 874	(108 to 127)	809	(117.5)
Waste fuel burner pressure	kPa (psig)	--	--	695	(101)
Waste atomization steam pressure	kPa (psig)	626 to 661	(91 to 96)	644	(93.5)
Boiler out O ₂	percent	5.60 to 6.36	(5.60 to 6.36)	5.98	(5.98)
Ringelman smoke number	--	--	(NA)	--	NA

^aFuel flow readouts from microprocessor for both oil and waste fuels

^bFuel flows calculated from totalizer readout of total gallons burned for both oil and waste fuels. These flows were considered as most representative.

^cWaste fuel flow readout from Hersey meter

NA -- Not available. Smoke monitor was inoperative during high boiler load test.

-- Indicates that no discernible change took place over duration of test

TABLE 44. BOILER OPERATION DATA -- SITE E TEST 8
(NATURAL GAS AND CHLORINATED TSB WASTE FUEL)

Parameter	Units	Range		Test Average	
Steam flow	kg/s (10 ³ lb/hr)	7.0 to 7.31	(55.5 to 58.0)	7.16	(56.75)
Steam pressure	MPa (psig)	2.83 to 2.96	(412 to 430)	2.90	(421)
Steam temperature	°C (°F)	293 to 299	(560 to 570)	296	(565)
Feedwater flow	kg/s (10 ³ lb/hr)	7.69 to 8.07	(61 to 64)	7.88	(62.5)
Feedwater temperature	°C (°F)	--	--	111	(232)
Economizer water out temperature	°C (°F)	185 to 188	(365 to 370)	186	(367.5)
Gas temperature, boiler out	°C (°F)	354 to 363	(670 to 685)	359	(677.5)
Gas temperature, economizer out	°C (°F)	--	--	165	(330)
Fan discharge pressure	kPa (in. H ₂ O)	2.09 to 2.16	(8.5 to 8.8)	2.13	(8.65)
Windbox pressure	kPa (in. H ₂ O)	0.96 to 0.98	(3.9 to 4.0)	0.97	(3.95)
Furnace pressure	kPa (in. H ₂ O)	0.59 to 0.61	(2.4 to 2.5)	0.60	(2.45)
Economizer out pressure	kPa (in. H ₂ O)	-0.07 to -0.09	(-0.3 to -0.4)	-0.08	(-0.35)
Natural gas flow ^a	l/s (10 ³ cfh)	347 to 360	(44.17 to 45.74)	354	(44.95)
Gas burner pressure	MPa (psig)	0.005	(0.72 to 0.75)	0.005	(0.735)
Waste fuel flow ^a	ml/s (gpm)	229 to 252	(3.64 to 4.01)	240	(3.87)
Waste fuel flow ^b	ml/s (gpm)	251 to 266	(4.0 to 4.23)	259	(4.11)
Waste fuel flow ^c	ml/s (gpm)	239 to 258	(3.8 to 4.1)	249	(3.95)
Waste fuel supply pressure	kPa (psig)	854 to 874	(124 to 127)	864	(125.5)
Waste fuel burner pressure	kPa (psig)	--	--	695	(101)
Waste atomization steam pressure	kPa (psig)	675 to 688	(98 to 100)	681	(99)
Boiler out O ₂	percent	4.25 to 5.04	(4.25 to 5.04)	4.64	(4.64)
Ringelman smoke number	--	--	--	--	(0)

^aFuel flow readouts from microprocessor for both natural gas and waste fuels

^bWaste flow calculated from totalizer readout of total gallons burned.

This waste flow was considered as most representative.

^cWaste fuel flow readout from Hersey meter

-- Indicates that no discernible change took place over duration of test

TABLE 45. BOILER OPERATION DATA -- SITE E TEST 9
(NATURAL GAS AND TOLUENE/MMA WASTE FUEL)

Parameter	Units	Range		Test Average	
Steam flow	kg/s (10 ³ lb/hr)	5.17 to 5.80	(41 to 46)	5.48	(43.5)
Steam pressure	MPa (psig)	2.82 to 2.90	(410 to 421)	2.86	(415.5)
Steam temperature	°C (°F)	290 to 296	(555 to 565)	293	(560)
Feedwater flow	kg/s (10 ³ lb/hr)	5.80 to 6.30	(46 to 50)	6.05	(48)
Feedwater temperature	°C (°F)	--	--	111	(232)
Economizer water out temperature	°C (°F)	174 to 179	(345 to 355)	177	(350)
Gas temperature, boiler out	°C (°F)	318 to 327	(605 to 620)	323	(612.5)
Gas temperature, economizer out	°C (°F)	146 to 154	(295 to 310)	150	(302.5)
Fan discharge pressure	kPa (in. H ₂ O)	2.24 to 2.58	(9.1 to 10.5)	2.41	(9.8)
Windbox pressure	kPa (in. H ₂ O)	0.52 to 0.86	(2.1 to 3.5)	0.69	(2.8)
Furnace pressure	kPa (in. H ₂ O)	0.18 to 0.29	(0.75 to 1.2)	0.24	(0.975)
Economizer out pressure	kPa (in. H ₂ O)	-0.07 to -0.10	(-0.3 to -0.42)	-0.09	(-0.36)
Natural gas flow ^a	l/s (10 ³ cfh)	194 to 215	(24.66 to 27.31)	204	(25.98)
Gas burner pressure	MPa (psig)	0.002	(0.24 to 0.26)	0.002	(0.25)
Waste fuel flow ^a	ml/s (gpm)	216 to 250	(3.43 to 3.98)	233	(3.70)
Waste fuel flow ^b	ml/s (gpm)	206 to 265	(3.27 to 4.21)	235	(3.74)
Waste fuel flow ^c	ml/s (gpm)	208 to 258	(3.3 to 4.1)	233	(3.7)
Waste fuel supply pressure	kPa (psig)	743 to 757	(108 to 110)	750	(109)
Waste fuel burner pressure	kPa (psig)	688 to 695	(100 to 101)	692	(100.5)
Waste atomization steam pressure	kPa (psig)	640 to 661	(93 to 96)	650	(94.5)
Boiler out O ₂	percent	4.33 to 6.33	(4.33 to 6.33)	5.33	(5.33)
Kingelmann smoke number	--	0 to 0.22	(0 to 0.22)	0.11	(0.11)

^afuel flow readouts from microprocessor for both natural gas and waste fuels

^bWaste flow calculated from totalizer readout of total gallons burned.

This waste flow was considered as most representative.

^cWaste fuel flow readout from Hersey meter

-- Indicates that no discernible change took place over duration of test

4.6 SITE F

TABLE 46. FLOWRATES AND SAMPLING DATA -- SITE F

Description	Test 1 Baseline	Test 2 Cofire	Test 3 Cofire	Test 4 Cofire
Flue gas flowrate				
m ³ /s	4.587	4.805	4.847	4.504
(10 ³ dscfm)	(9.720)	(10.182)	(10.271)	(9.543)
Flue gas sampled				
• Modified Method 5, m ³	8.072	8.377	9.132	8.530
(dscf)	(285.1)	(295.8)	(322.5)	(301.2)
• VOST ^a , liters	17.96 17.90	18.14 18.08 18.02	18.19 18.10 18.01	17.80 17.77
(dscf)	(0.634) (0.632)	(0.641) (0.639) (0.636)	(0.642) (0.639) (0.636)	(0.628) (0.627)
• HCl train ^b , m ³	0.422 0.416	0.415 0.596	0.439 0.641	0.579 0.468
(dscf)	(14.9) (14.7)	(14.6) (21.0)	(15.5) (22.7)	(20.5) (16.5)
Moisture in flue gas, percent	8.6	8.6	9.2	10.0
Average stack O ₂ , percent dry	8.6	8.0	8.5	8.5

^aThree samples were taken during each test except for test 4^bTwo samples were taken during each test

TABLE 47. BOILER OPERATING CONDITIONS -- SITE F

Parameter	Test 1 Baseline	Test 2 Cofire	Test 3 Cofire	Test 4 Cofire
Steam flow, kg/s (1,000 lb/hr)	4.0 (32)	4.0 (32)	4.0 (32)	4.0 (32)
Air flow, kg/s (1,000 lb/hr)	4.9 (39)	5.2 (41)	5.2 (41)	4.8 (38)
Excess air (percent)	66	59	63	65
Oil flow, liter/sec (gph)	0.251 (239)	0.215 (204)	0.220 (209)	0.210 (200)
Thinner flow, liter/sec (gph)	--	0.028 (27)	0.035 (33)	0.030 (29)
Windbox pressure, Pa (in. H ₂ O)	250 (1.0)	270 (1.1)	300 (1.2)	300 (1.2)
Furnace draft, Pa (in. H ₂ O)	-19 (-0.075)	-17 (-0.067)	-16 (-0.065)	-20 (-0.08)
Uptake draft, Pa (in. H ₂ O)	-93 (-0.373)	-97 (-0.39)	-100 (-0.41)	-92 (-0.37)
Drum level, Pa (in. H ₂ O)	160 (0.64)	141 (0.57)	134 (0.54)	190 (0.75)
Steam header pressure, kPa (psig)	814 (118)	814 (118)	814 (118)	814 (118)
Steam burner pressure, kPa (psig)	717 (104)	717 (104)	717 (104)	717 (104)
Oil pump pressure, MPa (psig)	1.48 (215)	1.48 (215)	1.48 (215)	1.48 (215)
Oil burner pressure, kPa (psig)	320 (47)	300 (43)	300 (44)	290 (42)
Thinner header pressure, kPa (psig)	--	170 (24)	170 (25)	170 (25)
Thinner burner pressure, kPa (psig)	--	170 (25)	180 (26)	180 (26)
Steam pressure, kPa (psig)	869 (126)	869 (126)	876 (127)	876 (127)
Efficiency, percent ^a	79.6	79.0	78.7	79.2

4.7 SITE G

TABLE 48. FLOWRATE AND SAMPLING DATA -- SITE G

Description	Test 1	Test 2	Test 3
Flue gas flowrate:			
m ³ /s	2.17	2.03	2.03
(10 ³ dscfm)	(4.60)	(4.30)	(4.30)
Flue gas sampled:			
• Modified Method 5			
m ³	6.03	6.31	7.05
(dscf)	(213)	(223)	(249)
• VOST ^a			
Liters	20.522	20.368	21.297
	20.732	20.661	22.678
	20.175	20.630	19.862
(dscf)	(0.724)	(0.719)	(0.752)
	(0.732)	(0.729)	(0.801)
	(0.712)	(0.728)	(0.701)
• HCl train ^b			
m ³	(0.439)	0.481	0.632
	(0.487)	0.468	0.529
(dscf)	(15.5)	(16.0)	(22.32)
	(17.2)	(16.5)	(18.67)
Moisture in flue gas percent ^c	2.4	3.7	3.8
Average stack O ₂ percent dry ^c	8.7	8.6	8.7

^aThree VOST samples taken per test. Each sample consists of two sorbent traps, one Tenax, and one Tenax/charcoal

^bTwo samples taken per test

^cMoisture and O₂ measurements taken at the stack (HCl scrubber outlet)

TABLE 49. THROX OPERATING CONDITIONS -- SITE G TEST 1

	Range	Average
<u>Boiler Steam and Feed Rates</u>		
Condensate flowrate, l/s (gpm)	1.39 to 2.04 (22.2 to 32.6)	1.73 (27.7)
Steam pressure, MPa (psig)	1.60 to 1.62 (232 to 236)	1.61 (234)
Steam temperature, °C (°F)	201 TO 202 (394 TO 396)	202 (395)
Feed firing rate, ml/s (gpm)	208 to 222 (3.33 to 3.55)	215 (3.43)
<u>Combustion Air and Boiler Pressure Drop</u>		
Atomizing air flowrate, g/s (lb/hr)	72.3 to 73.8 (573 to 585)	73.0 (579)
Outlet flue O ₂ concentration, percent	7.79 TO 8.01	7.0
Flue pressure drop across boiler, kPa (in. H ₂ O)	1.25 to 1.38 (5.0 to 5.5)	1.33 (5.3)
Boiler outlet flue pressure, kPa (in. H ₂ O)	-3.90 to -3.75 (-56.6 to -15.0)	-3.83 (-15.3)
<u>Boiler Flue Gas Temperatures</u>		
Firebox out (first pass) 1, °C (°F)	897 to 907 (1,650 to 1,660)	902 (1,660)
Firebox out (first pass) 2, °C (°F)	864 to 876 (1,590 to 1,610)	870 (1,600)
Second pass 1, °C (°F)	300 to 302 (572 to 576)	301 (574)
Second pass 2, °C (°F)	281 to 283 (538 to 541)	282 (542)
Boiler out (third pass), °C (°F)	222 to 224 (430 to 435)	223 (433)
<u>Recovery Scrubber Column</u>		
Inlet water flowrate, l/s (gpm) ^a	5.3 (84)	5.3 (84)
Flue gas temperature inlet (bottom), °C (°F)	63.1 to 63.9 (146 to 147)	63.5 (146)
Flue gas temperature outlet (top), °C (°F)	37.3 to 41 (99 to 106)	39.1 (102)
Recycle water flowrate, l/s (gpm)	2.26 to 2.53 (36.2 to 40.4)	2.39 (38.3)
Outlet water flowrate, l/s (gpm) ^a	5.3 (84)	5.3 (84)
<u>HCl Caustic Scrubber Column</u>		
Inlet water flowrate, l/s (gpm)	93.8 to 10.5 (150 to 168)	9.94 (159)
Caustic flowrate, ml/s (gpm)	125 to 188 (2 to 3)	156 (2.5)
Discharge, pH	8.98 to 9.03	9.0
Column pressure drop, Pa (in. H ₂ O)	-32.5 to -92.5 (-0.13 to -0.37)	-55.0 (-0.22)
<u>Induced Draft Blower Upstream of Damper</u>		
Flue gas temperature outlet, °C (°F)	29.5 to 30.8 (85 to 87)	30.0 (86)
Blower suction, kPa (in. H ₂ O)	-5.43 to -5.53 (-21.71 to -22.12)	-5.48 (-21.91)

TABLE 50. THROX OPERATING CONDITIONS -- SITE G TEST 2

	Range	Average
<u>Boiler Steam and Feed Rates</u>		
Condensate flowrate, l/s (gpm)	1.48 to 2.28 (23.7 to 36.5)	1.88 (30.1)
Steam pressure, MPa (psig)	1.56 to 1.50 (227 to 232)	1.58 (230)
Steam temperature, °C (°F)	200 to 201 (392 to 394)	201 (393)
Feed firing rate, ml/s (gpm)	209 to 220 (3.34 to 3.52)	214 (3.43)
<u>Combustion Air and Boiler Pressure Drop</u>		
Atomizing air flowrate, g/s (lb/hr)	69.1 to 72.6 (548 to 576)	70.9 (562)
Outlet flue O ₂ concentration, percent	7.6 to 8.0	7.8
Flue pressure drop across boiler, kPa (in. H ₂ O)	1.31 to 1.38 (5.22 to 5.52)	1.34 (5.37)
Boiler outlet flue pressure, kPa (in. H ₂ O)	-3.54 to -3.78 (-14.16 to -15.10)	-3.66 (-14.63)
<u>Boiler Flue Gas Temperatures</u>		
Firebox out (first pass) 1, °C (°F)	887 to 895 (1,630 to 1,640)	891 (1,640)
Firebox out (first pass) 2, °C (°F)	857 to 871 (1,570 to 1,600)	864 (1,590)
Second pass 1, °C (°F)	299 to 300 (570 to 572)	300 (572)
Second pass 2, °C (°F)	281 to 283 (538 to 541)	282 (540)
Boiler out (third pass), °C (°F)	221 to 222 (430 to 432)	221 (430)
<u>Recovery Scrubber Column</u>		
Inlet water flowrate, l/s (gpm)	5.2 (82)	5.2 (82)
Flue gas temperature inlet (bottom), °C (°F)	61.3 to 62.5 (142 to 145)	61.9 (143)
Flue gas temperature outlet (top), °C (°F)	33.2 to 36.9 (92 to 98)	35.0 (95)
Recycle water flowrate, l/s (gpm)	2.26 to 2.92 (36.2 to 46.7)	2.59 (41.4)
Outlet water flowrate, l/s (gpm)	5.2 (82)	5.2 (82)
<u>HCl Caustic Scrubber Column</u>		
Inlet water flowrate, l/s (gpm)	9.81 to 10.9 (157 to 175)	10.4 (166)
Caustic flowrate, ml/s (gpm)	No change	188 (3)
Discharge, pH	8.93 to 9.06	8.99
Column pressure drop, Pa (in. H ₂ O)	-67.5 to -7.50 (-0.27 to 0.03)	-30.0 (-0.12)
<u>Induced Draft Blower Upstream of Damper</u>		
Flue gas temperature outlet, °C (°F)	26.7 to 29.1 (80 to 84)	27.9 (82)
Blower suction, kPa (in. H ₂ O)	-5.44 to -5.53 (-21.75 to -22.12)	-5.48 (-21.93)

TABLE 51. THROX OPERATING CONDITIONS -- SITE G TEST 3

	Range	Average
<u>Boiler Steam and Feed Rates</u>		
Condensate flowrate, l/s (gpm)	1.56 to 1.90 (25.0 to 30.4)	1.89 (30.3)
Steam pressure, MPa (psig)	1.56 to 1.59 (227 to 231)	1.58 (229)
Steam temperature, °C (°F)	200 to 201 (392 to 394)	201 (393)
Feed firing rate, ml/s (gpm)	198 to 228 (3.16 to 3.65)	213 (3.40)
<u>Combustion Air and Boiler Pressure Drop</u>		
Atomizing air flowrate, g/s (lb/hr)	66.6 to 69.7 (528 to 553)	68.1 (540)
Outlet flue O ₂ concentration, percent	8.2 to 10.0	9.1
Flue pressure drop across boiler, kPa (in. H ₂ O)	1.30 to 1.35 (5.19 to 5.39)	1.32 (5.29)
Boiler outlet flue pressure, kPa (in. H ₂ O)	-3.68 to -3.89 (-14.73 to -15.54)	-3.78 (-15.13)
<u>Boiler Flue Gas Temperatures</u>		
Firebox out (first pass) 1, °C (°F)	872 to 904 (1,600 to 1,660)	888 (1,630)
Firebox out (first pass) 2, °C (°F)	831 to 882 (1,530 to 1,620)	856 (1,570)
Second pass 1, °C (°F)	297 to 301 (567 to 574)	299 (570)
Second pass 2, °C (°F)	278 to 283 (532 to 541)	280 (536)
Boiler out (third pass), °C (°F)	220 to 221 (428 to 432)	221 (430)
<u>Recovery Scrubber Column</u>		
Inlet water flowrate, l/s (gpm)	5.2 (82)	5.2 (82)
Flue gas temperature inlet (bottom), °C (°F)	60.8 to 62.8 (141 to 145)	61.8 (143)
Flue gas temperature outlet (top), °C (°F)	34.3 to 37.4 (94 to 99)	35.8 (96)
Recycle water flowrate, l/s (gpm)	2.36 to 3.26 (37.8 to 52.1)	2.81 (45.0)
Outlet water flowrate, l/s (gpm)	5.2 (82)	5.2 (82)
<u>HCl Caustic Scrubber Column</u>		
Inlet water flowrate, l/s (gpm)	9.31 to 10.3 (149 to 165)	9.81 (157)
Caustic flowrate, ml/s (gpm)	125 to 188 (2 to 3)	156 (2.5)
Discharge, pH	8.98 to 9.01	8.99
Column pressure drop, Pa (in. H ₂ O)	-52.5 to 20.0 (-0.21 to 0.08)	-32.5 (-0.13)
<u>Induced Draft Blower Upstream of Damper</u>		
Flue gas temperature outlet, °C (°F)	27.1 to 29.3	28.2 (83)
Blower suction, kPa (in. H ₂ O)	-5.46 to -5.50 (-21.83 to -21.99)	-5.48 (-2)

TABLE 52. SUMMARY OF HEAT INPUT AND OUTPUT --SITE G

	Test 1	Test 2	Test 3
Heat input, MW (million Btu/hr)	5.23 (17.8)	5.02 (17.1)	5.26 (17.9)
Heat output, MW (million Btu/hr) ^a	4.27 (14.6)	4.17 (14.2)	4.36 (14.9)
Thermal efficiency (percent): ^b	81.9	83.2	83.1
Heat loss due to dry gas	9.8	9.5	9.2
Heat loss due to H ₂ O in the flue gas	6.8	5.8	6.2
Heat loss due to radiation	1.0	1.0	1.0
Unmeasured losses	0.5	0.5	0.5
Total heat loss (percent)	18.1	16.8	16.9

^aCalculated based on boiler thermal efficiency from heat loss method and total heat input

^bBased on ASME heat loss method using boiler outlet conditions:
efficiency = 1 - total heat loss

4.8 SITE H

TABLE 53. BOILER OPERATING CONDITIONS -- SITE H

	Test 1 Baseline		Test 2 Cofire		Test 3 Cofire		Test 4 Cofire	
	Range	Average	Range	Average	Range	Average	Range	Average
Steam								
Steam flow, kg/s (10 ³ lb/hr)	30.7 to 21.2 (244 to 248)	31.0 (246)	30.9 to 31.5 (245 to 250)	31.4 (249)	31.4 to 31.5 (248 to 250)	31.4 (489)	30.5 to 31.5 (242 to 250)	31.1 (247)
Steam pressure, MPa	4.4 to 4.6 (640 to 660)	4.4 (644)	4.4 (640)	4.4 (640)	4.4 (640)	4.4 (640)	4.4 (640 to 650)	4.4 (644)
Steam temperature, °C	393 to 394 (740 to 742)	393 (740)	388 to 404 (730 to 760)	396 (740)	385 to 391 (725 to 735)	387 (728)	382 to 385 (720 to 725)	384 (723)
Feed water temperature, °C	135 to 138 (275 to 280)	136 (277)	135 (275)	135 (275)	135 (275)	135 (275)	135 to 146 (279 to 295)	138 (280)
Combustion Air and Flue Gas								
Air heater inlet temperature, °C	24 to 27 (75 to 80)	26 (78)	27 to 32 (80 to 90)	29 (85)	27 to 32 (80 to 90)	29 (85)	16 to 24 (60 to 75)	20 (68)
Air heater inlet pressure, kPa	1.7 to 1.8 (6.8 to 7.3)	1.8 (7.1)	1.1 to 1.4 (4.6 to 5.7)	1.2 (5.0)	1.2 to 1.3 (4.7 to 5.3)	1.3 (5.1)	1.2 to 1.3 (4.9 to 5.4)	1.3 (5.1)
Air heater outlet temperature, °C	291 to 299 (555 to 570)	293 (559)	288 to 304 (550 to 580)	297 (566)	302 to 304 (575 to 580)	303 (578)	293 to 302 (560 to 575)	297 (567)
Pulverizer mill air temperature, °C	82 to 85 (180 to 185)	84 (183)	77 to 85 (170 to 185)	82 (179)	82 to 85 (180 to 185)	82 (180)	82 to 85 (180 to 185)	84 (182)
Windbox pressure, kPa	900 to 950 (3.6 to 3.8)	-920 (3.7)	420 to 600 (1.7 to 2.4)	500 (2.0)	450 to 520 (1.8 to 2.1)	500 (2.0)	450 to 600 (1.9 to 2.4)	550 (2.2)
Furnace pressure, kPa	-120 to -150 (-0.5 to -0.6)	-145 (-0.59)	-120 to -200 (-0.5 to -0.8)	-150 (-0.6)	-150 (-0.6)	-150 (-0.6)	-120 to -150 (0.5 to 0.6)	-134 (0.54)
Air heater gas inlet °C	385 to 410 (725 to 770)	396 (745)	382 to 410 (720 to 770)	399 (750)	399 to 404 (750 to 760)	404 (759)	371 to 391 (700 to 735)	383 (722)
Air heater inlet pressure, kPa	-250 to -400 (-1.0 to -1.6)	-350 (-1.4)	-250 to -375 (-1 to -1.5)	-300 (-1.2)	-250 to -350 (-1.0 to -1.4)	-300 (-1.2)	-250 (-1.0)	-250 (-1.0)
Air heater gas outlet °C	171 to 177 (340 to 350)	174 (345)	177 to 182 (350 to 360)	181 (357)	182 to 188 (360 to 370)	185 (365)	177 to 179 (350 to 355)	178 (353)
Air heater gas outlet kPa	-1.5 to -1.9 (-6.0 to -7.5)	-1.8 (-7.1)	-1.3 to -1.6 (-5.2 to -6.9)	-1.4 (-5.8)	-1.3 to -1.9 (-5.4 to -7.7)	-1.6 (-6.6)	-1.1 to -1.5 (-4.6 to -6.2)	-1.4 (-5.5)
Stack temperature, °C	160 to 171 (320 to 340)	166 (330)	160 to 171 (320 to 340)	167 (333)	171 (340)	171 (340)	163 to 171 (325 to 340)	168 (335)

4.9 SITE I

TABLE 54. BOILER OPERATING PARAMETERS DURING TEST PERIODS -- SITE I

Test	1				2				3				4			
	Background unstaged combustion				Liquid waste staged combustion				Background staged combustion				Liquid waste unstaged combustion			
Firing conditions	1	2	3	4	5	6	7	8	12	9	10	11	10	9	10	11
Actual test numbers	1	2	3	4	5	6	7	8	12	9	10	11	10	9	10	11
Process parameters (average over the test period)																
-Steam production rate (1000 lb/hr of 175 psf steam)	40.2	40.3	40.5	40.1	41.2	40.5	39.1	39.9	40.5	40.1	40.0	40.3	40.1	40.5	40.0	40.3
-Fuel gas flow rate (lb/hr)	2022.8	2097.2	2102.8	1885.8	1863.3	1877.0	2004.7	2062.3	2128.6	1874.0	1878.6	1916.4	1874.0	2128.6	1878.6	1916.4
-Aniline waste flow rate (lb/hr)	0	0	0	362.8	362.8	362.8	0	0	0	356.8	361.6	362.8	356.8	0	361.6	362.8
-Air flow indicator ^c (% of scale)	39.3	39.3	40.2	36.0	37.9	36.0	37.9	39.0	38.4	35.3	35.2	35.9	35.3	38.4	35.2	35.9
-Wind box pressure (in. W.C.)	2.5	2.6	2.7	3.0	3.2	2.9	2.8	3.0	3.2	2.8	2.7	2.8	3.2	3.0	2.8	2.8
-Furnace pressure (in. W.C.)	1.3	1.3	1.3	1.4	1.6	1.5	1.4	1.3	1.4	1.5	1.3	1.5	1.4	1.3	1.5	1.5
-Stack pressure (in. W.C.)	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
-Flue gas temperature (°C)	239.3	240.7	241.7	241.6	243.8	240.2	239.4	242.5	245.5	243.4	242.2	246.0	245.5	243.4	242.2	246.0

^aUnstaged combustion means that the air registers for the upper and lower burners are open by the same amount and the combustion air split between the upper and lower burners is about 50/50, respectively.

^bStaged combustion means that the air register to the lower burner is restricted and that the air split between the upper and lower burners is about 65/35, respectively.

^cThis instrument has never been calibrated by host; no factors exist to convert these readings into absolute units.

TABLE 55. HEAT INPUT TO BOILER -- SITE I

Test	Fuel Gas			Fuel Gas Flow			Fuel Gas Heat Input (MMBtu/hr)	Waste Feed			Waste Feed Flow		Waste Feed Heat Input (MMBtu/hr)	Total Heat Input (MMBtu/hr)
	Heating Value Btu/ft ³	Specific Gravity	lb/hr	scfm	Heating Value Btu/lb	Specific Gravity		gpm	lb/hr					
1	1083	0.606	2022.8	748.65		48.65	-	-	-	-	-	-	48.65	
2	1033	0.588	2097.2	776.19		48.11	-	-	-	-	-	-	48.11	
3	1035	0.591	2102.8	778.26		48.33	-	-	-	-	-	-	48.33	
4	1032	0.590	1885.8	697.95		43.22	10,534	0.60	362.8	3.82			47.04	
5	1033	0.592	1883.3	697.02		43.20	10,596	0.60	362.8	3.84			47.04	
6	1032	0.586	1877.0	694.69		43.02	10,721	0.60	362.8	3.89			46.91	
7	1029	0.580	2004.7	741.95		45.81	-	-	-	-	-	-	45.81	
8	1036	0.595	2062.3	763.27		47.44	-	-	-	-	-	-	47.44	
9	1023	0.585	1874.0	693.58		42.57	10,627	0.60	356.8	3.79			46.36	
10	1032	0.591	1878.6	695.28		43.05	10,610	0.60	361.6	3.84			46.89	
11	1025	0.584	1916.4	709.27		43.62	10,660	0.60	362.8	3.87			47.49	
12	1033	0.590	2128.6	787.81		48.83	-	-	-	-	-	-	48.83	

4.10 SITE J

TABLE 56. MODIFIED METHOD 5 SAMPLING PARAMETERS -- SITE J

Condition Number	Run Number	Date	Sample Volume (SCFD) ^a	XAD Inlet Temp. (°F)		Average Filter Temp. (°F)	Stack Gas Flow (SCFMD) ^a	Excess Air (%)	Average Stack Temp. (°F)	Stack Gas Moisture (%)
				Avg.	Max.					
1	MM5-1	7/27	33.997	32	41	402	1040	38.4	404	9.2
	MM5-2	7/28	36.057	50	66	403	1116	37.5	400	8.8
	MM5-3	7/28	34.971	49	56	402	1126	37.5		
2	MM5-4	7/29	32.415	55	69	406	1728	37.4	537	11.3
	MM5-8	8/02	62.890	49	62	401	1740	34.7	551	9.5
	MM5-9	8/02	58.907	53	69	413	1725	41.0	552	9.4
3	MM5-5	8/01	62.588	44	65	407	1167	34.7	434	9.4
	MM5-6	8/01	63.641	52	65	412	1222	34.7	444	8.7
	MM5-7	8/02	64.350	53	72	408	1105	22.7	453	8.4
4	MM5-10	8/03	60.308	49	52	404	1779	41.0	486	8.7
	MM5-11	8/03	59.528	40	55	414	1767	41.0	503	6.6
	MM5-12	8/03	59.914	54	64	409	1690	41.0	510	8.7
5	MM5-13	8/04	52.257	53	60	381	933	41.0	417	9.3
	MM5-14	8/04	52.737	52	55	384	949	54.2	414	8.0
	MM5-15	8/04	55.889	47	64	414	947	54.2	414	8.2
6	MM5-16	8/05	124.515	46	59	402	1642	17.2	556	10.6
	MM5-17	8/05	87.785	42	49	412	1649	17.2	558	10.1

^a Standard conditions (29.92 in. Hg, 68°F) dry.

TABLE 57. COMPOSITE FUEL AND POHC'S FEEDRATE -- SITE J

Test condition (no.)	Date	Fuel Blend No.	Conditions	Fuel feed lb/hr
1	7/27	1	Half load	234
	7/28	1	Half load	262
	7/28	1	Half load	202
2	7/29	1	Full load	425
	8/2	1	Full load	448
	8/2	1	Full load	497
3	8/1	2	Half load	252
	8/1	2	Half load	252
	8/2	2	Half load	255
4	8/3	1	Full load (high EA)	395
	8/3	1	Full load (high EA)	429
	8/3	1	Full load (high EA)	377
5	8/4	1	Half load (high EA)	185
	8/4	1	Half load (high EA)	185
	8/4	1	Half load (high EA)	185
6	8/5	2	Full load	451
	8/5	2	Full load	498
	8/5	2	Full load	481

TABLE 58. BOILER OPERATING CONDITIONS -- SITE J

Run	Date (1983)	Average boiler ext. temp. (°F)	Average steam press (psig)	Minimum press (psig)	Maximum press (psig)
1	7/27	355	47	45	52
2	7/28	376	39	30	55
3	7/28	353	43	40	48
4	7/29	517	53	50	60
5	8/1	403	40	40	40
6	8/1	408	44	38	48
7	8/2	413	43	40	48
8	8/2	531	88	78	100
9	8/2	522	88	70	110
10	8/3	508	91	78	110
11	8/3	503	92	80	105
12	8/3	503	89	80	100
13	8/4	380	59	50	68
14	8/4	375	59	55	72
15	8/4	377	73	70	80
16	8/5	504	80	60	105
17	8/5	510	87	70	100

4.11 SITE K

TABLE 59. SUMMARY OF CONTINUOUSLY MONITORED BOILER OPERATING PARAMETERS -- SITE K

Monitored Parameter	Test Set No. 1 100% No. 6 Oil Firing				Test Set No. 2 Heavy Oil and Spiked Light Oil Firing ^a			
	Run No. 1	Run No. 2	Run No. 3	Average, Runs No. 1,2,3	Run No. 5	Run No. 6	Run No. 7	Average, Runs No. 5,6,7
Boiler steam production rate (10 ³ lb/hr)	48.2	48.6	48.8	48.5	48.8	48.6	49.1	48.8
Bridgwall O ₂ (dry, vol %)								
-Radian meter	3.83	3.78	3.72	3.78	3.86	4.32	3.80	3.99
-Plant meter	2.9	3.0	3.0	3.0	2.9	3.0	3.0	3.0
Heavy oil flow (gpm)	6.8	6.8	6.8	6.8	3.6	3.6	3.8	3.7
Light oil flow (gpm)	0.0	0.0	0.0	0.0	3.9	3.9	4.0	3.9
Percent light oil ^b (flow basis)	0.0	0.0	0.0	0.0	52.0	52.0	51.3	51.8
Furnace pressure (in. H ₂ O)	-0.41	-0.43	-0.46	-0.43	-0.43	-0.49	-0.50	-0.47
Windbox pressure (in. H ₂ O)	1.23	1.32	1.32	1.29	2.16	1.40	1.49	1.68
ID fan pressure (in. H ₂ O)	-0.10	-0.10	-0.10	-0.10	-0.10	-0.11	-0.10	-0.10
Flue gas temperature (°F)	627.2	617.6	623.6	622.8	651.2	652.9	677.8	660.6
Steam drum pressure (psig)	140.3	140.2	140.2	140.2	140.3	140.4	140.8	140.5
Light oil API gravity ^c @ 60°F	-	-	-	-	32.5	33.4	28.0	31.3
Light oil specific gravity (60°/60°)	-	-	-	-	0.863	0.858	0.867	0.869

^aHeavy oil = 70% No. 6 oil/30% waste solvent. Light oil = spiked waste solvent.

^bValue calculated manually using light oil and heavy oil flow rates.

^cValue based on API gravity measurements (corrected to 60°F) of light oil fuel samples taken at 30 minute intervals during test runs.

^dValue calculated from the equation sp. gr. $(\frac{60^\circ}{60^\circ}) = 141.5 / (^\circ\text{API} @ 60^\circ\text{F} + 131.5)$.

TABLE 60. MASS FLOWRATES OF HEAVY AND LIGHT FUEL OILS DURING THE
TEST RUNS -- SITE K

Run Number	Heavy Oil Mass Flow Rate (lb/hr)	Light Oil Mass Flow Rate (lb/hr)
<u>Test Set Number 1^a</u>		
Run No. 1	3,107	-
Run No. 2	3,125	-
Run No. 3	3,308	-
Average, Test Set No. 1	3,180	-
<u>Test Set Number 2^b</u>		
Run No. 5	1,601	1,704
Run No. 6	1,603	1,671
Run No. 7	1,694	1,776
Average, Test Set No. 2	1,633	1,717

^aTest set number one = background tests with No. 6 oil in the heavy oil train.

^bTest set number two = hazardous waste tests with 70% No. 6 oil/30% waste solvent in the heavy oil train and spiked waste solvent in the light oil train.

TABLE 61. CONTRIBUTIONS OF HEAVY AND LIGHT OILS TO THE TOTAL ROILER
HEAT INPUT DURING THE TEST RUNS -- SITE K

Run Number	Heavy Oil Heat Input (MMBtu/hr)	Light Oil Heat Input (MMBtu/hr)	Total Heat Input (MMBtu/hr)	% Light Oil (Energy Basis)
<u>Test Set Number 1^a</u>				
Run No. 1	57.50	-	57.50	-
Run No. 2	57.54	-	57.54	-
Run No. 3	61.03	-	61.03	-
Average, Test Set No. 1	58.69	-	58.69	-
<u>Test Set Number 2^b</u>				
Run No. 5	30.12	-	58.81	-
Run No. 6	29.10	28.67	57.77	49.63
Run No. 7	30.89	30.11	61.00	49.36
Average, Test Set No. 2	30.04	29.16	59.20	49.26

^aTest set number one = background tests with 100% No. 6 oil in the heavy oil train.

^bTest set number two = hazardous waste tests with 70% No. 6 oil/30% waste solvent in heavy oil train and spiked waste solvent in the light oil train.

SECTION 5

SUMMARY OF ANALYTICAL AND EMISSION DATA

- 5.1 Site A
- 5.2 Site B
- 5.3 Site C
- 5.4 Site D
- 5.5 Site E
- 5.6 Site F
- 5.7 Site G
- 5.8 Site H
- 5.9 Site I
- 5.10 Site J
- 5.11 Site K

5.1 SITE A

TABLE 62. DRE OF ORGANIC COMPOUNDS -- SITE A

Compound	Test 2	Test 3	Test 4
<u>Acids:</u>			
Phenol ^a	>99.999	>99.999	>99.997
2,4-Dimethylphenol ^a	>99.995	>99.982	>99.979
4-Nitrophenol	99.896	99.980	99.856
Pentachlorophenol ^a	99.985	99.975	99.996
2-Nitrophenol	NA	NA	NA
4-Chloro-m-creosol	NA	NA	96.400
<u>Base/neutrals:</u>			
Bis-(2-chloroethoxy)-methane ^a	>99.997	NA	NA
2,4-Dinitrotoluene	>99.998	NA	NA
2,6-Dinitrotoluene	>99.999	NA	NA
Naphthalene ^a	99.988	99.997	99.955
Acenaphthylene	<78.000	>99.991	>99.990
Acenaphthene	99.817	99.675	>99.991
Fluorene ^a	99.997	99.986	>99.999
Phenanthrene	99.965	99.980	99.989
Anthracene	99.831	99.991	99.999
Fluoranthene	99.300	99.233	99.767
Pyrene	99.995	99.996	99.999
Chrysene	<86.000	<97.400	99.999
Diphenylamine	>99.930	99.978	NA
<u>Other compounds:</u>			
Methylnaphthalenes	99.960	99.982	99.996
Biphenyl	>99.999	>99.999	>99.998
Dibenzofuran	99.823	99.924	99.998
Cyclopenta(d,e,f,)phenanthrene	>99.982	99.992	>99.978
Methylpyrenes	>99.994	99.992	>99.986

^aPrincipal organic hazardous constituents per RCRA appendix VIII present in significant concentration in the creosote

NA -- DRE cannot be calculated because the concentrations in the waste fuel and flue gas sample were below the detection limit

TABLE 63. ORGANIC EMISSIONS, TEST NO. 1 (WOOD AND CREOSOTE) -- SITE A

Compound	Flowrates (µg/sec)	
	Flue Gas	Ash Streams ^a
<u>Acids:</u>		
Phenol ^b	220	0.14
2,4-Dimethylphenol ^b	13	0.04
4-Nitrophenol ^b	<13	0.04
Pentachlorophenol ^b	<3.2	1.2
2-Nitrophenol	16	<7
4-Chloro-m-creosol ^b	11	<7
<u>Base/neutrals:</u>		
Nitrobenzene ^b	4.5	0.04
Naphthalene ^b	25	1.3
Acenaphthylene	<3.2	0.02
Acenaphthene	<0.6	0.02
Fluorene ^b	<0.6	0.02
Phenanthrene	<0.6	1.3
Anthracene	<0.6	0.2
Fluoranthene ^b	<0.6	<1.4
Pyrene	<0.6	<1.4
Diphenylamine	<6.4	0.04
<u>Other compounds:</u>		
Methylnaphthalenes	1.3	0.05
Biphenyl	<6.4	<14
Dibenzofuran	0.6	0.2
Cyclopenta(d,e,f,)phenanthrene	<6.4	<14
Methylpyrenes	<6.4	0.18
Methylphenol	24	<14
Hydroxymethoxybenzaldehyde	58	0.17
Benzoic acid	49	<14

^aCombined emissions from bottom ash and collected flyash streams

^bPrincipal organic hazardous constituents per RCRA appendix VIII

TABLE 64. COFIRING TEST NO. 2 (WOOD AND CREOSOTE) -- SITE A

Compound	Flowrates (ug/sec)			DRE (percent)	DRE ^a Without Background (percent)
	Creosote	Flue Gas	Ash Streams		
Acids:					
	110,000				
Phenol ^b	65,000	<0.6	0.1	>99.999	>99.999
2,4-Dimethylphenol ^b	65,000	<3.2	<7	>99.995	>99.995
2,4-Dichlorophenol ^b	<250	<3.2	<7	NA	NA
2,4,6-Trichlorophenol ^b	<250	<3.2	<7	NA	NA
4-Nitrophenol ^b	14,000	14.6	<29	99.896	99.896
Pentachlorophenol ^b	300,000	44	<5.5	99.985	99.985
2-Nitrophenol	<250	<3.2	<7	NA	NA
4-Chloro-m-cresol ^b	<250	<3.2	<7	NA	NA
2-Chlorophenol	<250	<3.2	<7	NA	NA
Base/neutrals:					
Bis (2-chloroethoxy)-methane ^b	24,000	<0.6	<1.4	>99.997	>99.997
Nitrobenzene ^b	<50	<0.6	<0.4	NA	NA
2,4-Dinitrotoluene ^b	39,000	<0.6	<1.4	>99.998	>99.998
2,6-Dinitrotoluene ^b	65,000	<0.6	<1.4	>99.999	>99.999
Naphthalene ^b	950,000	133	1	99.986	99.988
Acenaphthylene	<50	11	<1.4	<78.000	<78.000
Acenaphthene	12,000	22	<1	99.817	99.817
Fluorene ^b	380,000	10	<1.4	99.997	99.997
Phenanthrene	650,000	228	<2.1	99.965	99.965
Anthracene	13,000	22	<1.1	99.831	99.831
Fluoranthene ^b	7,000	49	<1.7	99.300	99.300
Pyrene	750,000	37	<1.4	99.995	99.995
Chrysene ^b	<50	7	<1.3	<86.000	<86.000
1,2-Dichlorobenzene ^b	<50	<0.6	<1.4	NA	NA
1,3-Dichlorobenzene ^b	<50	<0.6	<1.4	NA	NA
1,4-Dichlorobenzene ^b	<50	<0.6	<1.4	NA	NA
Diphenylamine	9,000	<6.3	<4.1	>99.930	>99.930
1,2,4-Trichlorobenzene ^b	<50	<0.6	<1.4	NA	NA
Other compounds:					
Methylnaphthalenes	110,000	45	1	99.959	99.960
Biphenyl	430,000	<6.3	<14	>99.999	>99.999
Dibenzofuran	43,000	76	<10	99.823	99.823
Cyclopenta(d,e,f,)phenanthrene	34,000	<6.3	<14	>99.982	>99.982
Methylpyrenes	95,000	<6.3	<14	>99.994	>99.994
9H-Fluorenone	<500	61	<14	<87.800	<87.800

^aDRE calculated using flue gas emissions minus background levels established during the baseline test

^bPrincipal organic hazardous constituents per RCRA appendix VIII

^cNA -- DRE cannot be calculated because the concentration in the waste fuel and flue gas samples were below the detection limit

TABLE 65. COFIRING TEST NO. 3 (WOOD AND CREOSOTE) -- SITE A

Compound	Flowrates (µg/sec)			DRE (percent)	DRE ^a Without Background (percent)
	Creosote	Flue Gas	Ash Streams		
Acids:					
Phenol ^b	40,000	2.5	<0.5	99.994	>99.999
2,4-Dimethylphenol ^b	18,000	<3.2	<7	>99.982	>99.982
2,4-Dichlorophenol ^b	<250	<3.2	<7	NA	NA
2,4,6-Trichlorophenol ^b	<250	<3.2	<7	NA	NA
4-Nitrophenol ^b	10,000	15	<20	99.850	99.980
Pentachlorophenol ^b	110,000	28	<5.4	99.975	99.975
2-Nitrophenol	<250	<3.2	<7	NA	NA
4-Chloro-m-cresol ^b	<250	<3.2	<2.3	NA	NA
2-Chlorophenol	<250	3.8	<7	<98.480	<98.480
Base/neutrals:					
Bis (2-chloroethoxy)-methane ^b	<50	<0.6	<1.4	NA	NA
Nitrobenzene ^b	<50	<0.6	<0.4	NA	NA
2,4-Dinitrotoluene ^b	<50	<0.6	<1.4	NA	NA
2,6-Dinitrotoluene ^b	<50	<0.6	<1.4	NA	NA
Naphthalene ^b	300,000	35	1.1	99.988	99.997
Acenaphthylene	7,000	<0.6	<1.4	>99.991	>99.991
Acenaphthene	8,000	26	<1	99.675	99.675
Fluorene ^b	250,000	34	<1	99.986	99.986
Phenanthrene	350,000	70	<1.7	99.980	99.980
Anthracene	150,000	14	<1.1	99.991	99.991
Fluoranthene ^b	3,000	23	<1.4	99.233	99.233
Pyrene	420,000	15	<1.4	99.996	99.996
Chrysene ^b	<50	1.3	<1.2	<97.400	<97.400
1,2-Dichlorobenzene ^b	<50	1.3	<1.4	<97.400	<97.400
1,3-Dichlorobenzene ^b	<50	<0.6	<1.4	NA	NA
1,4-Dichlorobenzene ^b	<50	<0.6	<1.4	NA	NA
Diphenylamine	6,000	1.3	<10	99.978	99.978
1,2,4-Trichlorobenzene ^b	<50	<0.6	<1.4	NA	NA
Other compounds:					
Methylnaphthalenes	70,000	14	2.9	99.980	99.982
Biphenyl	420,000	<6.3	<14	>99.999	>99.999
Dibenzofuran	44,000	34	<16	99.923	99.924
Cyclopenta(d,e,f,)phenanthrene	31,000	2.5	<14	99.992	99.992
Methylpyrenes	80,000	1.3	<14	99.998	99.992
9H-Fluorenone	<500	<6.3	<10	NA	NA

^aDRE calculated using flue gas emissions minus background levels established during the baseline test

^bPrincipal organic hazardous constituents per RCRA appendix VIII

^cNA -- DRE cannot be calculated because the concentration in the waste fuel and flue gas samples were below the detection limit

TABLE 66. COFIRING TEST NO. 4 (WOOD AND CREOSOTE) -- SITE A

Compound	Flowrates (µg/sec)			DRE (percent)	DRE ^a Without Background (percent)
	Creosote	Flue Gas	Ash Streams		
<u>Acids:</u>					
Phenol ^b	29,000	18	0.05	99.938	>99.997
2,4-Dimethylphenol ^b	15,000	<3.2	<7	>99.979	>99.979
2,4-Dichlorophenol ^b	<250	3.8	<7	<98.480	<98.480
2,4,6-Trichlorophenol ^b	<250	12	<7	<95.200	<98.200
4-Nitrophenol ^b	9,000	<13	<28	>99.856	>99.856
Pentachlorophenol ^b	110,000	4.4	<5	99.996	99.996
2-Nitrophenol	<250	7	<7	<97.200	NA
4-Chloro-m-cresol ^b	<250	20	<7	<92.000	96.400
2-Chlorophenol	<250	3.2	<7	<98.720	<98.720
<u>Base/neutrals:</u>					
Bis (2-chloroethoxy)-methane ^b	<50	<0.6	<1.4	NA	NA
Nitrobenzene ^b	<50	2.5	<1.4	<95.000	NA
2,4-Dinitrotoluene ^b	<50	<0.6	<1.4	NA	NA
2,6-Dinitrotoluene ^b	<50	<0.6	<1.4	NA	NA
Naphthalene ^b	270,000	146	1.6	99.946	99.955
Acenaphthylene	6,000	<0.6	<1	>99.990	>99.990
Acenaphthene	7,000	<0.6	<1.4	>99.991	>99.991
Fluorene ^b	220,000	<0.6	<1.4	>99.999	>99.999
Phenanthrene	320,000	34	<1.7	99.989	99.989
Anthracene	120,000	1.3	<1.1	99.999	99.999
Fluoranthene ^b	3,000	7	<1.6	99.767	99.767
Pyrene	310,000	2.5	<1.4	99.999	99.999
Chrysene ^b	120,000	0.6	<1.3	99.999	99.999
1,2-Dichlorobenzene ^b	<50	5.7	<1.2	<88.600	<88.600
1,3-Dichlorobenzene ^b	<50	4.4	<1.4	<91.200	<91.200
1,4-Dichlorobenzene ^b	<50	2.5	<1.4	<95.000	<95.000
Diphenylamine	<500	<6.3	<10	NA	NA
1,2,4-Trichlorobenzene ^b	<50	3.2	<1.4	<93.600	<93.600
<u>Other compounds:</u>					
Methylnaphthalenes	65,000	3.8	61	99.994	99.996
Biphenyl	260,000	<6.3	<6	>99.998	>99.998
Dibenzofuran	48,000	1.3	<15	99.997	99.998
Cyclopenta(d,e,f,)phenanthrene	29,000	<6.3	<14	>99.978	>99.978
Methylpyrenes	44,000	<6.3	<14	>99.986	>99.986
9H-Fluorenone	<500	<6.3	<14	NA	NA

^aDRE calculated using flue gas emissions minus background levels established during the baseline test^bPrincipal organic hazardous constituents per RCRA appendix VIII^cNA -- DRE cannot be calculated because the concentration in the waste fuel and flue gas samples were below the detection limit

TABLE 67. VOLATILE ORGANIC EMISSIONS,^a $\mu\text{g}/\text{sec}$ -- SITE A

Compound	Test			
	1	2	3	4
Benzene	<60	<100	<65	450
Toluene	210	57	26	480
Ethylbenzene	80	<10	<6	330
Chlorobenzene	<3	<5	<3	14

^aDetection limits for other compounds is 3 $\mu\text{g}/\text{sec}$ and 60 $\mu\text{g}/\text{sec}$ for acrolein and acrylonitrile.

TABLE 68. FUEL ANALYSIS, DRY BASIS -- SITE A

	Cofiring				Average of Tests	Creosote
	Test 1a	Test 2	Test 3	Test 4		
<u>Composition</u> <u>Weight percent:</u>						
C	50.54	52.21	51.12	50.93	51.42	88.45
H	5.58	5.85	6.18	5.94	5.99	8.74
N	0.10	0.10	0.12	0.10	0.11	2.03
Cl ⁻	0.24	0.15	0.21	0.21	0.19	0.51
Ash	0.70	0.65	0.82	1.11	0.86	0.26
O ₂ (by difference)	42.84	41.04	41.55	41.71	41.43	-- ^c
H ₂ O ^b	31.78	43.29	43.69	42.74	43.24	24.14 ^c
<u>Gross Heating</u> <u>Value^d:</u>						
kJ/kg	19,740	20,320	19,590	19,790	19,990	38,730
(Btu/lb)	(8,503)	(8,757)	(8,440)	(8,525)	(8,574)	(16,690)

^aWood waste burned during the test 1 contained same solvent contaminants noticeable by volatile hydrocarbons emanating from fuel at ambient temperature

^bA portion of the moisture concentration is attributable to volatile hydrocarbons with boiling points less than 100°C (212°F)

^cEstimated values, H₂O by difference assuming O₂ concentration to be negligible

^dHeating values may be underestimated because of probable loss of volatile hydrocarbons during analysis

TABLE 69. CREOSOTE ANALYSIS RESULTS, mg/ml -- SITE A

Test	2	3	4
<u>Acids:</u>			
Phenol ^a	1.3	0.80	0.58
2,4-Dimethylphenol ^a	1.3	0.36	0.30
4-Nitrophenol	0.28	0.20	0.18
Pentachlorophenol ^a	6.0	2.2	2.2
<u>Base/neutrals:</u>			
Bis(2-chloroethoxy)-methane ^a	0.48	ND	ND
2,4-Dinitrotoluene	0.73	ND	ND
2,6-Dinitrotoluene	1.3	ND	ND
Naphthalene ^a	19	6.0	5.4
Acenaphthylene	ND	0.14	0.12
Acenaphthene	0.25	0.16	0.14
Fluorene ^a	7.6	5.0	4.4
Phenanthrene	13	7.0	6.4
Anthracene	0.26	3.0	2.4
Fluoranthene	0.14	0.06	0.06
Pyrene	15	8.4	6.2
Chrysene	ND	ND	2.4
Dyphenylamine	0.18	0.12	ND
<u>Other compounds:</u>			
Methylnaphthalenes	2.2	1.4	1.3
Biphenyl	8.6	8.4	5.2
Dibenzofuran	0.86	0.88	0.96
Cyclopenta(d,e,f)phenanthrene	0.68	0.62	0.58
Methylpyrenes	1.9	1.6	0.88

^aPrincipal organic hazardous constituents per RCRA appendix VIII present in significant concentrations

ND -- Not detected. Concentrations are below the detection limit of 1 µg/ml

5.2 SITE B

TABLE 70. DRE'S OF ORGANIC COMPOUNDS WITHOUT BACKGROUND CORRECTION -- SITE B

Compounds	DRE (percent)		
	Test 2 ^a	Test 3	Test 4 ^b
<u>RCRA Appendix VIII</u>			
Naphthalene	99.3	81	13/96
Pentachlorophenol	>99.6	NAC	>70/>98.9
Toluene	>99.999	-- ^d	84/99.991
Weighted total	>99.999	53	86.8/99.98
<u>Other Semivolatile and Nonvolatile</u>			
Xylenes	>99.999	98.2	99.94/99.994
C ₃ -Alkylbenzenes	>99.999	99.998	98.1/99.990
C ₄ -Alkylbenzenes	99.7/99.89	99.85	>98.8/>99.997
Benzoic acid	>99.999	99.92	>99.96/>99.988
1,2-Benzenedicarboxylic acid	>99.996	>99.7	>96/>97
Methyl-1,1-biphenyl	>99.8	>99.5	>97/>99.8
Methylnaphthalenes	NA	35.4	90.7
Benzaldehyde	NA	NA	52
Weighted total	>99.999	99.94	>99.85/>99.994

^aHigh and low values are based upon duplicate analyses of flue gas samples

^bHigh and low values are based upon analyses of three waste samples. Single value indicates only one value reported above detection limit.

^cNA -- not applicable, not detected in waste stream

^dOutlet flowrate greater than inlet. Potential product of incomplete combustion (PIC).

TABLE 71. DRE'S OF ORGANIC COMPOUNDS AFTER BACKGROUND CORRECTION -- SITE B

Compounds	DRE (percent)		
	Test 2	Test 3	Test 4 ^a
<u>RCRA Appendix VIII</u>			
Naphthalene	>99.9	>99.7	>98.77/>99.95 ^b
Pentachlorophenol	>99.6 ^c	NA ^d	>70/>98.9 ^c
Toluene	>99.999	20	>98/>99.999 ^b
Weighted total	>99.999	>82	>98/>99.999
<u>Other Semivolatile and Volatile</u>			
Xylenes	>99.999	99.6	99.98/99.998
C ₃ -Alkylbenzenes	>99.999	>99.999 ^b	98.5/99.994
C ₄ -Alkylbenzenes	>99.9 ^b	>99.99 ^b	>98.8/>99.997 ^b
Benzoic acid	>99.999 ^c	99.92 ^c	>99.96/>99.988 ^c
1,2-Benzenedicarboxylic acid	>99.996 ^c	>99.7 ^c	>96/>97 ^c
Methyl-1,1-biphenyl	>99.8 ^c	>99.5 ^c	>97/>99.8 ^c
Methylnaphthalenes	NA	95.7	96.9
Benzaldehyde	NA	NA	87.2
Weighted total	>99.999	>99.95	>99.90/>99.995

^aTwo numbers indicate high and low values depending on which of three waste analyses was used. Single value indicates only one waste concentration reported above detection limit.

^bBackground concentration greater than cofiring test concentration. DRE based on emissions at detectible limit.

^cBackground correction not applied, compound was below detection limit for baseline test

^dNA -- not applicable, not detected in waste stream

TABLE 72. TEST NO. 1 (BASELINE) -- SITE B

Compounds	Flue Gas Outlet	
	($\mu\text{g}/\text{sec}$)	($\mu\text{g}/\text{dscm}$)
<u>RCRA Appendix VIII</u>		
Naphthalene	2.4	6.95
Pentachlorophenol	<0.23	<0.66
Toluene	2.3	6.69
<u>Other Semivolatile and Nonvolatile</u>		
Xylenes	3.7	10.63
C ₃ -Alkylbenzenes	0.32	0.92
C ₄ -Alkylbenzenes	0.18	0.52
Benzoic acid	<0.45	<1.31
Benzaldehyde	0.90	2.62
Ethylbenzaldehyde	2.4	7.08
1,2-Benzenedicarboxylic acid	<0.45	<1.31
Methyl-1,1-biphenyl	<0.05	<0.13
Methylnaphthalenes	0.36	1.05

TABLE 73. DRE'S FOR FIRST COFIRING TEST, TEST NO. 2 -- SITE B

Compounds	Residue Inlet ($\mu\text{g}/\text{sec}$)	Flue Gas Outlet ^a ($\mu\text{g}/\text{sec}$)	DRE (percent)	DRE Without Background (percent)
<u>RCRA Appendix VIII</u>				
Naphthalene	250	1.6/1.9	99.3	>99.9 ^b
Pentachlorophenol	59	<0.2	>99.6	>99.6 ^c
Toluene	4,800,000	2.9/2.8	>99.999	>99.999
Weighted Total			>99.999	>99.999
<u>Other Semivolatile and Nonvolatile</u>				
Xylenes	17,000,000	3.1/4.7	>99.999	>99.999
C ₃ -Alkylbenzenes	840,000	0.2/0.4	>99.999	>99.999
C ₄ -Alkylbenzenes	74	0.08/0.2	99.7/99.89	>99.9 ^b
Benzoic acid	44,000	<0.4	>99.999	>99.999 ^c
1,2-Benzenedicarboxylic acid	>10,000	<0.4	>99.996	>99.996 ^c
Methyl-1,1-biphenyl	25	<0.04	>99.8	>99.8 ^c
Weighted Total			99.999	>99.999

^aAnalyzed in duplicate, single entries are provided where only one value was reported

^bBackground concentration greater than test concentration. DRE based on emissions at detectable limit

^cUnchanged DRE because background concentration was below detection limit

TABLE 74. DRE'S FOR SECOND COFIRING TEST, TEST NO. 3 -- SITE B

Compounds	Residue Inlet ($\mu\text{g}/\text{sec}$)	Flue Gas Outlet ($\mu\text{g}/\text{sec}$)	DRE (percent)	DRE Without Background (percent)
<u>RCRA Appendix VIII</u>				
Naphthalene	12	2.2	81	>99.7 ^a
Toluene	3.4	5.0	NAB ^b	20
Weighted Total			53	>82
<u>Other Semivolatile and Nonvolatile</u>				
Xylenes	280	5.0	98.2	99.6
C ₃ -Alkylbenzenes	13,600	0.27	99.998	>99.999 ^a
C ₄ -Alkylbenzenes	126	0.19	99.85	>99.99 ^a
Benzoic acid	23,700	18	99.92	99.92 ^c
1,2-Benzenedicarboxylic acid	120	<0.38	>99.7	>99.7 ^c
Methyl-1,1-biphenyl	8.9	<0.04	>99.5	>99.5 ^c
Methylnaphthalenes	0.65	0.42	35.4	95.7
Weighted Total			99.94	>99.95

^aBackground concentration greater than test concentration. DRE based on emissions at detectable limit

^bNA -- not applicable, outlet greater than inlet

^cDRE unchanged because background concentration was below detection limit

TABLE 75. DRE'S FOR THIRD COFIRING TEST, TEST NO. 4 -- SITE B

Compounds	Residue Inlet ^a (ug/sec)	Flue Gas Outlet (ug/sec)	DRE (percent) (low/high)	DRE Without Background (percent) (low/high)
<u>RCRA Appendix VIII</u>				
Naphthalene	2.4/57/3.3	2.1	13/96	>98.77/>99.95 ^b
Pentachlorophenol	0.53/9.6/16	<0.17	>70/>98.9	>70/>98.9 ^c
Toluene	270/18,400/10.0	1.6	84/99.991	>98/>99.999 ^b
Weighted Total			86/99.98	>98/>99.999
<u>Other Semivolatile and Nonvolatile</u>				
Xylenes	8,970/92,400/76,300	5.1	99.94/99.994	99.98/99.998
C ₃ -Alkylbenzenes	904/13,600/67	1.3	98.1/99.990	98.5/99.994
C ₄ -Alkylbenzenes	3.3/1,540/33.5	<0.04	>98.8/>99.997	>98.8/>99.997 ^c
Benzoic acid	10,400/39,800/37,500	<4.6	>99.96/>99.988	>99.96/>99.988 ^c
1,2-Benzenedicarboxylic acid	9.0/11/<2.6	<0.35	>96/>97	>96/>97 ^c
Methyl-1,1-biphenyl	1.3/23/<0.26	<0.04	>97/>99.8	>97/>99.8 ^c
Methylnaphthalenes	<0.27/5.7/<0.27	0.53	90.7	96.9
Benzaldehyde	2.5/<2.7/<2.7	1.2	52	87.2
Weighted Total			>99.85/>99.994	>99.90/>99.995

^aBased on analysis results of three separate waste residue samples^bBackground concentration greater than test concentration. DRE based on emission at detectable limit.^cDRE unchanged because background concentration was below detection limit

TABLE 76. WASTE SAMPLE COMPOSITION -- SITE B

Compounds	Concentration (mg/l)			
	Test 2	Test 3	Test 4 ^a	
<u>RCRA Appendix VIII</u>				
Naphthalene	6.8	0.36	0.071	1.7
Pentachlorophenol	1.6	ND ^b	0.016	0.288
Toluene	129,000	0.100	8.2	550
<u>Other Semivolatile and Nonvolatile</u>				
Xylenes	469,000	8.2	268	2,760
C3-Alkylbenzenes	22,600	400	27	405
C4-Alkylbenzenes	2	3.7	0.100	46
Benzoic acid	1,180	695	310	1,190
Benzaldehyde	ND	ND	0.075	ND
1,2 Benzenedicarboxylic acid	>270 ^c	3.5	0.27	0.32
Methyl-1,1-biphenyl	0.68	0.26	0.039	0.7
Methylnaphthalenes	ND	0.019	ND	0.17
				2,280
				2
				1
				1,120
				ND
				ND
				ND
				ND

^aThree samples were taken and analyzed separately^bNot detected^cDetector saturated

5.3 SITE C

TABLE 77. DRE'S OF ORGANIC COMPOUNDS -- SITE C

Compounds	DRE (percent)		
	Test 1	Test 2	Test 3
<u>RCRA Appendix VIII</u>			
Phenol	99.998	>99.999	>99.999
Bis (2-ethylhexyl)phthalate	99.1	98.3	96
Dibutylphthalate	NA	NA	99.3
Weighted total	99.998	99.998	99.996
<u>Other Semivolatiles and</u>			
<u>Nonvolatiles^a</u>			
C ₃ -Alkylbenzenes ^b	>99.998	99.997	>99.999
C ₃ -Alkylbenzenes ^b	>99.999	>99.999	>99.999
Benzene acetaldehyde	>99.999	>99.999	>99.999
2,2'-Methylenebisphenol	99.998	>99.998	>99.993
4,4'-Methylenebisphenol	99.998	>99.998	>99.991
Pyrene	>99.94	>99.8	99.5
C ₁₅ H ₁₆ O ^b	>99.999	>99.999	>99.999
C ₁₅ H ₁₆ O ^b	>99.998	>99.998	>99.998
C ₁₈ H ₂₀	>99.999	>99.999	>99.999
C ₁₆ H ₂₀ O	>99.999	>99.999	>99.999
Weighted total	>99.999	>99.999	>99.999

^aWith the exception of pyrene, the identification of these compounds is tentative and quantification is approximate

^bDifferent isomers

NA -- Compound not detected in waste

TABLE 78. BASELINE TEST -- SITE C

Compound	Emissions ^a	
	µg/dscm	µg/s
<u>RCRA Appendix VIII</u>		
Phenol	2.5	32
Dibutylphthalate	3.7	49
Bis(2-ethylhexyl)phthalate	29	370
<u>Other Semivolatiles and</u>		
<u>Nonvolatiles^b</u>		
C ₃ -Alkylbenzene ^c	11	140
C ₃ -Alkylbenzene ^c	ND	ND
Benzene acetaldehyde	ND	ND
2,2'-Methylenebisphenol	0.1	1.6
4,4'-Methylenebisphenol	0.4	5
Pyrene	<0.1	<2
C ₁₅ H ₁₆ O ^c	ND	ND
C ₁₅ H ₁₆ O ^c	ND	ND
C ₁₈ H ₂₀	ND	ND
C ₁₆ H ₁₈ O	ND	ND

^aAll emissions are blank corrected

^bWith the exception of pyrene, the identification of these compounds is tentative; quantification is approximate

^cDifferent isomers

ND -- Not detected. Detection limit corresponds to 8 µg/s or 0.6 µg/dscm.

TABLE 79. TEST 2, COFIRING -- SITE C

Compound	Waste Residue (mg/s)	Flue Gas ^a (μg/s)	DRE (Percent)	DRE Without Background ^b (Percent)
<u>RCRA Appendix VIII</u>				
Phenol	15,000	190	99.998	99.998
Bis(2-ethylhexyl)phthalate	15	130	99.1	>99.989
Weighted total			99.998	99.998
<u>Other Semivolatiles and</u>				
<u>Nonvolatiles^c</u>				
C ₃ -Alkylbenzene ^d	27,000	370	99.998	>99.999
C ₃ -Alkylbenzene ^d	10,000	<8.4	>99.999	>99.999
Benzene acetaldehyde	1,300	<8.4	>99.999	>99.999
2,2'-Methylenebisphenol	890	13	99.998	99.998
4,4'-Methylenebisphenol	920	13	99.998	>99.999
Pyrene	2.7	<1.7	>99.94	>99.94
C ₁₅ H ₁₆ O ^d	2,000	<8.4	>99.999	>99.999
C ₁₅ H ₁₆ O ^d	430	<8.4	>99.998	>99.998
C ₁₈ H ₂₀	>6,400	<8.4	>99.999	>99.999
C ₁₆ H ₁₈ O	>8,800	<8.4	>99.999	>99.999
Weighted total			>99.999	>99.999

^aAll emissions are blank corrected

^bDRE calculated using flue gas emissions minus background levels established during the baseline test

^cWith the exception of pyrene, the identification of these compounds is tentative; quantification is approximate

^dDifferent isomers

TABLE 80. TEST 3, COFIRING -- SITE C

Compound	Waste Residue (mg/s)	Flue Gas ^a (μg/s)	DRE (Percent)	DRE Without Background ^b (Percent)
<u>RCRA Appendix VIII Compounds</u>				
Phenol	12,000	30	>99.999	>99.999
Bis(2-ethylhexyl)phthalate	10	170	98.3	>99.983
Weighted total			99.998	>99.999
<u>Other Semivolatiles and Nonvolatiles^c</u>				
C ₃ -Alkylbenzene ^d	27,000	880	99.997	99.997
C ₃ -Alkylbenzene ^d	10,000	<8.4	>99.999	>99.999
Benzene acetaldehyde	1,600	<8.4	>99.999	>99.999
2,2'-Methylenebisphenol	450	<8.4	>99.998	>99.998
4,4'-Methylenebisphenol	550	<8.4	>99.998	>99.999
Pyrene	1.0	<2	>99.998	>99.8
C ₁₅ H ₁₆ O ^d	2,000	<8.4	>99.999	>99.999
C ₁₅ H ₁₆ O ^d	550	<8.4	>99.998	>99.998
C ₁₈ H ₂₀	>7,200	<8.4	>99.999	>99.999
C ₁₆ H ₁₈ O	>11,500	<8.4	>99.999	>99.999
Weighted total			>99.999	>99.999

^aAll emissions are blank corrected^bDRE calculated using flue gas emissions minus background levels established during the baseline test^cWith the exception of pyrene, the identification of these compounds is tentative; quantification is approximate^dDifferent isomers

TABLE 81. TEST 4, COFIRING -- SITE C

Compound	Waste Residue (mg/s)	Flue Gas ^a (ug/s)	DRE (Percent)	DRE Without Background ^b (Percent)
<u>RCRA Appendix VIII Compounds</u>				
Phenol	13,000	28	>99.999	>99.999
Dibutylphthalate	30	220	99.3	99.4
Bis(2-ethylhexyl)phthalate	7.8	260	96	>99.983
Weighted total			99.996	99.9987
<u>Other Semivolatiles and Nonvolatiles^c</u>				
C ₃ -Alkylbenzene ^d	25,000	61	>99.999	>99.999
C ₃ -Alkylbenzene ^d	11,000	<8.3	>99.999	>99.999
Benzene acetaldehyde	1,300	<8.3	>99.999	>99.999
2,2'-Methylenebisphenol	120	<8.3	>99.993	>99.993
4,4'-Methylenebisphenol	93	<8.3	>99.991	>99.991
Pyrene	1.0	5	99.5	99.5
C ₁₅ H ₁₆ O ^d	1,900	<8.3	>99.999	>99.999
C ₁₅ H ₁₆ O ^d	760	<8.3	>99.998	>99.999
C ₁₈ H ₂₀	>8,400	<8.3	>99.999	>99.999
C ₁₆ H ₁₈ O	>9,600	<8.3	>99.999	>99.999
Weighted total			>99.999	>99.999

^aAll emissions are blank corrected^bDRE calculated using flue gas emissions minus background levels established during the baseline test^cWith the exception of pyrene, the identification of these compounds is tentative; quantification is approximate^dDifferent isomers

TABLE 82. OTHER ORGANIC EMISSIONS^a -- SITE C

Compound ^b	Test 1 Baseline	Cofired Test		
		2	3	4
Butylbenzylphthalate	2.4	0.8	ND	ND
Dibutylphthalate	3.7	2.1	1.8	17 ^c
Diethylphthalate	ND	0.1	ND	1.3
Di-n-octylphthalate	5.3	0.3	ND	2.3
Phenanthrene	ND	ND	ND	1.0
Chrysene	ND	ND	ND	0.6
Fluoranthene	ND	ND	ND	0.5
Benzo(a)anthracene	ND	ND	ND	0.4
Xylenes	10	16	18	17
C ₁₁ H ₂₄	12	2.5	27	110
Ethylbenzaldehyde	ND	ND	0.8	0.8

^aEmissions are in micrograms per dry standard cubic meter.
All are blank corrected. (To obtain micrograms per second multiply by 13.)

^bCompounds not detected in the waste fuel

^cAlso detected in the waste fuel

ND -- Compound not detected or concentration in blank sample equal to or greater than concentration of test sample

TABLE 83. VOLATILE ORGANIC EMISSIONS^a -- SITE C

Compound	Test 1 Baseline	Cofired Test			
		2	3	4 ^b	4 ^b
<u>RCRA Appendix VIII</u>					
Toluene	1,200	460	880	270	270
Benzene	180	<6	<6	<6	<6
Trichloroethylene	27	25	<6	<5	<5
<u>Other Volatiles</u>					
Hexane	1,700	<6	<6	<5	<5
Methylene chloride	2,700	NA	150	90	100

^aIn micrograms per dry standard cubic meter. To convert emissions to micrograms per second multiply by 13. All emissions corrected for blank except for methylene chloride.

^bTwo samples taken and analyzed

NA -- Compound was detected but concentration could not be quantified

TABLE 84. COMPOSITION OF PHENOLIC WASTE -- SITE C

Component	Cofired Test		
	2	3	4
Percent, dry basis:			
Carbon, C	83.23	84.02	82.99
Hydrogen, H	7.84	7.91	7.81
Nitrogen, N	0.69	0.65	0.80
Sulfur, S	0.07	0.06	0.07
Chlorine, Cl	0.02	0.03	0.01
Ash	0.08	0.08	0.07
Oxygen, O (by difference)	8.07	7.25	8.20
Moisture, percent	0.45	0.50	0.60
Heating value, Btu/lb	16,498	16,525	16,799

TABLE 85. ORGANIC COMPOUNDS DETECTED IN THE PHENOLIC WASTE^a -- SITE C

Compound	Cofired Test		
	1	2	3
<u>RCRA Appendix VIII</u>			
Phenol	56	47	53
Bis(2-ethylhexyl)phthalate	0.055	0.042	0.031
Dibutylphthalate	ND	ND	0.120
<u>Other Semivolatiles and</u>			
<u>Nonvolatiles^b</u>			
C ₃ -Alkylbenzene ^c	100	110	100
C ₃ -Alkylbenzene ^c	38	40	45
Benzene acetaldehyde	4.7	6.4	5.0
2,2'-Methylenebisphenol	3.3	1.8	0.46
4,4'-Methylenebisphenol	3.4	2.2	0.37
Pyrene	0.010	0.004	0.004
C ₁₅ H ₁₆ O	7.4	8.1	7.5
C ₁₅ H ₁₆ O	1.6	2.2	3.0
C ₁₈ H ₂₀	24	29	38
C ₁₆ H ₁₈ O	33	46	38
Total organics, percent	27	29	29

^aGrams per liter^bWith the exception of pyrene and C₃-alkylbenzenes, the identification of these compounds is tentative, quantification is approximate^cDifferent isomers

ND -- Not detected, below 1.0 µg/ml

5.4 SITE D

TABLE 86. C₁ TO C₆ GASEOUS HYDROCARBON EMISSIONS, ppm -- SITE D

Test No.	Time Sample Was Taken	Hydrocarbons						Total C ₁ to C ₆
		C ₁	C ₂	C ₃	C ₄	C ₅	>C ₆	
1	1610	-- ^a	--	--	--	--	--	--
	1705	--	--	--	--	--	9.4	9.4
	(average)	--	--	--	--	--	(5)	(5)
2	950	--	--	2.1	--	--	--	2.1
	1150	--	--	11.5	1.8	--	--	13.3
	1605	--	--	14.6	0.8	--	--	15.4
	(average)	--	--	(9.4)	(1.3)	--	--	(11)
3	910	--	--	1.9	--	--	--	1.9
	1125	--	--	17.8	2.7	--	20.5	41
	1225	--	--	6.4	1.3	--	--	8.3
	1545	--	--	1.9	--	--	--	1.9
	(average)	--	--	(7)	(2)	--	(10)	(19)
4	1330	2.0	--	19.2	1.0	--	11.9	34.1
	1430	1.8	--	1.9	12.3	27.1	14.6	57.7
	1600	--	--	1.1	4.5	--	--	5.6
	(average)	(2)	--	(7)	(6)	(9)	(9)	(32)
5 ^b	1020	--	--	--	1.4	43.8	--	45.2
	1255	--	--	--	--	--	17.9	17.9
	1440	--	--	--	1.7	60.1	--	61.8
	(average)	--	--	--	(2)	(35)	(6)	(42)
6 ^c	1030	--	--	--	--	2.2	--	2.2
	1145	--	--	17.3	--	3.6	25.3	46.2
	1340	--	--	18.0	--	4.3	5.7	28.0
	1532	--	--	5.5	--	13.7	3.8	23.0
	(average)	--	--	(10)	--	(6)	(9)	(25)
7 ^c	1245	--	--	--	--	15.6	--	15.6
	1405	--	--	--	2.0	2.7	5.8	10.5
	1528	--	--	--	--	4.6	11.8	16.4
	(average)	--	--	--	(1)	(8)	(6)	(14)

^aDashes indicate concentration was below the detection limit^bSample bulb contamination was experienced during this test. Results are questionable.^cSample bulbs were not used. Gas sample was drawn from continuous monitoring sample line.

TABLE 87. SUMMARY OF APRTICULATE CATCHES AND EMISSIONS -- SITE D

Test No.	Particulate Catches, mg			Total Emissions		
	Probe and Nozzle	Filter	Total	g/dscm (10 ⁻⁶ lb/ft ³)	ng/J (lb/10 ⁶ Btu)	10 ⁻³ Kg/s (lb/hr)
1	26.3	504.2	530.5	0.066 (4.13)	25.0 (0.058)	0.63 (5.00)
2	473.4	1,274.3	1,747.7	0.18 (11.27)	63.2 (0.147)	1.76 (13.94)
3	239.3	874.91	1,114.2	0.12 (7.52)	42.0 (0.098)	1.11 (8.84)
4	65.5	914.8	982.3	0.12 (7.32)	41.4 (0.096)	1.07 (8.48)
5	50.7	185.3	236.0	0.035 (2.19)	15.9 (0.037)	0.24 (1.88)
6	43.4	212.9	256.3	0.050 (3.10)	17.9 (0.042)	0.26 (2.03)
7	39.9	192.4	232.3	0.042 (2.62)	18.6 (0.043)	0.27 (2.12)

TABLE 88. FUEL ASH CONTRIBUTION TO PARTICULATE EMISSIONS -- SITE D

Test No.	Ash Input, 10 ⁻³ kg/s (lb/hr)			Total Particulate, Emissions 10 ⁻³ kg/s (lb/hr)	Particulate Emissions	
	From No. 6 Oil	From Waste Solvent	Total		Inorganic (Ash) ^a (percent)	Organic (Soot) ^a (percent)
1	0.293 (2.32)	--	0.293 (2.32)	0.63 (5.00)	46	54
2	0.227 (1.80)	0.290 (2.30)	0.517 (4.10)	1.76 (13.94)	29	71
3	0.218 (1.73)	0.464 (3.68)	0.682 (5.41)	1.11 (8.84)	61	39
4	0.245 (1.94)	0.227 (1.80)	0.472 (3.74)	1.07 (8.48)	44	56
5	0.091 (0.72)	0.033 (0.26)	0.124 (0.98)	0.24 (1.88)	52	48
6	0.088 (0.70)	<0.016 (<0.13)	0.105 (0.83)	0.26 (2.03)	41	59
7	0.086 (0.68)	<0.016 (<0.13)	0.102 (0.81)	0.27 (2.12)	38	62

^aThe distribution of total particulate between inorganic and organic matter assumes that no particulate matter is trapped in the boiler convective passes or flue gas ducts

TABLE 89. CHLORIDE (HCL) EMISSION RATES -- SITE D

Test No.	Reagent Final Volume (ml)	Chloride Concentration (mg/l)	Total Chloride (mg)	Flue Gas Volume Sampled Nm ³ (dscf)	Flue gas Flowrate Nm ³ /s (dscfm)	Chloride (HCl) Emissions	
						ng/J (lb/10 ⁶ Btu)	10 ⁻³ kg/s (lb/hr)
1	395	60	24	1.09 (38.5)	9.53 (20,190)	8.5 (0.020)	0.21 (1.7)
2	370	10,300	3,810	0.92 (32.4)	9.73 (20,610)	1,450 (3.37)	40.4 (320)
3	415	6,500	2,700	1.06 (37.5)	9.25 (19,590)	884 (2.06)	23.5 (186)
4	515	2,000	1,030	1.08 (38.2)	9.12 (19,320)	337 (0.784)	8.7 (69)
5	455	2,000	910	1.08 (38.0)	6.76 (14,330)	380 (0.884)	5.7 (45)
6	425	2,100	890	1.12 (39.5)	5.14 (10,900)	282 (0.657)	4.0 (32)
7	470	1,800	850	1.10 (39.0)	6.37 (13,490)	343 (0.798)	4.9 (39)

TABLE 90. CHLORINE BALANCE -- SITE D

Test No.	Chlorine Input 10 ⁻³ kg/s (lb/hr) From		Chloride Output (lb/hr) 10 ⁻³ kg/s	Chlorine Balance Out/In (percent) Based On	
	Ultimate Analysis	GC Analysis ^a		Ultimate Analysis	GC Analysis
1	0.18 (1.4)	--	0.21 (1.7)	--	121
2	57.9 (459)	65.7 (521)	40.4 (320)	70	61
3	60.2 (477)	59.3 (471)	23.5 (186)	39	39
4	9.1 (72)	10.0 (79)	8.7 (69)	96	87
5	2.6 (21)	5.0 (40)	5.7 (45)	214	113
6	4.2 (33)	5.0 (40)	4.0 (32)	97	80
7	3.8 (30)	5.3 (42)	4.9 (39)	130	93

^aFrom analysis of PCE concentrations in solvent stream no. 3 for tests 2, 3, and 4, and BCEE concentrations in solvent stream no. 6 for tests 5, 6, and 7

TABLE 91. PCE AND BCEE DRE CALCULATIONS -- SITE D

Test No.	Run No. ^a	POHC ^b Input Rate 10 ⁶ (μg/s)	POHCC Output Rate (μg/s)	DRE (percent)	Average Test DRE (percent)
2	1	76.7 ^d	570	99.9993	99.999
	2	78.5 ^e	1,010	99.998	
	3	78.5 ^e	1,070	99.998	
3	1	69.3 ^d	540	99.9992	99.998
	2	15.7 ^e	510	99.996	
	3	15.7 ^e	850	99.994	
4	1	11.7 ^d	640	99.994	99.995
	2	23.5 ^e	1,370	99.994	
	3	23.5 ^e	560	99.997	
5	--	7.52 to 7.85	<3	>99.9999	>99.9999
6	--	7.47 to 7.59	4.2	99.9999	99.9999
7	--	7.58 to 7.82	6.8	99.9999	99.9999

^aTest runs correspond to the three Tenax samples taken for each test

^bPCE is POHC for tests 2, 3, and 4; BCEE is POHC for tests 5, 6, and 7

^cPCE emissions are based on results from analysis of Tenax sampling system samples. BCEE emissions are based on results from analysis of modified EPA Method 5 samples.

^dInput rate corresponds to morning (AM) waste fuel sample and recorded waste firing rate for that time period

^eInput rate corresponds to afternoon (PM) waste fuel sample and recorded waste firing rate for that time period

TABLE 92. ORGANIC EMISSIONS, TEST 1 (BASELINE) -- SITE D

Compound	Sample Concentration, ng							Emission Rate ^b (µg/s)	
Volatile Organics: (RCRA Appendix VIII)	Tenax Traps			Impinger ^a			Tenax ^a Blank		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3			
Tetrachloroethylene	110	160	79					180	
Bis(2-chloroethyl) ether	ND	ND	ND					--	
Benzene	120	360	58					280	
Toluene	210	930	420					800	
1,1,1-Trichloroethane	ND	480	190					350	
Trichloroethylene	ND	220	ND					110	
Semivolatile and Nonvolatile Organics	XAD-Sample Train							XAD Blank	Emission Rate ^a (µg/s)
• <u>RCRA Appendix VIII</u>									
Phenol	13,000							ND	15
1,3-Dichlorobenzene	4,100							ND	5.0
1,4-Dichlorobenzene	3,000							ND	3.6
Naphthalene	4,900							2,700	2.6
Diethylphthalate	9,900							2,000	9.4
Dibutylphthalate	12,000							6,400	6.7
Bis-2-ethylhexylphthalate	344,000							155,000	230
• <u>Others</u>									
Phenanthrene	1,100							ND	1.3
Butylbenzyl phthalate	10,000							8,200	2.1
Aliphatic hydrocarbon ^c	210,000							85,000	150
Alicyclic oxygen hydrocarbon ^c	74,000							44,000	36
Ethylbenzaldehyde ^d	38,000							ND	45
Benzoic acid ^d	20,000							33,000	--
Alkylbenzoic acid ^d	9,600							11,000	--
Hexadecanoic acid ^d	33,000							12,000	25
Aliphatic acid ^d	35,000							ND	42
Silicone ^c	24,000							63,000	--

^aNeither impinger solution nor Tenax blank samples were available for this test

^bEmissions are blank corrected

^cConcentration calculated using phenol-d₅ peak height

^dConcentration calculated using naphthalene-d₈

ND - Not detected, detection limit 20 ng for volatile organics and 1,000 to 5,000 ng for semivolatile organics

TABLE 93. ORGANIC EMISSIONS, TEST 2 (COFIRING WITH SOLVENT NO. 3) -- SITE D

Compound	Sample Concentration, ng							Emission Rate ^a (ug/s)
Volatile Organics: (RCRA Appendix VIII)	Tenax Traps			Impinger			Tenax Blank	
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3		
Tetrachloroethylene	52	67	250	340	610	460	39	900
Bis(2-chloroethyl) ether	ND	ND	ND	ND	ND	ND	ND	--
Benzene	510	210	540	NA	NA	NA	NA	680
Carbon tetrachloride	ND	ND	ND	100	ND	270	NA	200
Chloroform	ND	ND	ND	230	190	240	NA	360
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	NA	--
1,2-Dichloroethane	ND	ND	ND	85	ND	34	NA	64
1,1-Dichloroethylene	ND	ND	ND	260	160	240	NA	360
Toluene	55	900	440	NA	NA	NA	NA	750
Trichloroethylene	ND	ND	ND	18	37	ND	NA	30
1,1,1-Trichloroethane	ND	ND	ND	76	230	170	NA	260
1,1,2-Trichloroethane	ND	ND	ND	130	ND	69	NA	110
Dichloromethane	ND	810	ND	>1,000	>1,000	>1,000	NA	>2,100
Semivolatile and Nonvolatile Organics	XAD-Sample Train						XAD Blank	Emission Rate ^a (ug/s)
• RCRA Appendix VIII								
Bis(2-chloroethyl) ether	5,400						ND	5.4
Phenol	8,100						ND	8.1
1,4-Dichlorobenzene	6,100						ND	6.1
Naphthalene	16,000						2,700	13
2,4 Dichlorophenol	5,300						ND	5.3
2,4,6 Trichlorophenol	16,000						ND	16
Diethylphthalate	3,000						2,000	1.0
Dibutylphthalate	8,320						6,400	1.9
Bis-2-ethylhexylphthalate	30,000						155,000	--
• Others								
Phenanthrene	1,000						ND	1.0
Aliphatic hydrocarbon ^b	54,000						85,000	--
Alicyclic oxygen hydrocarbon ^b	122,000						44,000	78
Ethylbenzaldehyde ^c	46,000						ND	46
Benzoic acid ^c	87,000						33,000	54
Aromatic oxygen hydrocarbons ^b	50,000						ND	50
Hexadecanoic acid ^c	23,000						12,000	11
Chlorinated aromatic (MW284) ^c	22,000						ND	22
Molecular sulfur (S6-S8) ^c	106,000						ND	106
Silicone ^b	99,000						63,000	36

^aEmissions are blank corrected^bConcentration calculated using phenol-d₅ peak height^cConcentration calculated using naphthalene-d₈

ND = Not detected, detection limit 20 ng for volatile organics and 1,000 to 5,000 ng for semivolatile organics

NA - Compound not analyzed in the sample

TABLE 94. ORGANIC EMISSIONS, TEST 3 (COFIRING WITH SOLVENT NO. 3) -- SITE D

Compound	Sample Concentration, ng								
Volatile Organics: (RCRA Appendix VIII)	Tenax Traps			Impinger			Tenax ^e Blank	Emission ^a Rate ($\mu\text{g/s}$)	
	Run 1 ^b	Run 2 ^c	Run 3 ^d	Run 1	Run 2	Run 3			
	Tetrachloroethylene		31	100	350	300	450		720
Bis(2-chloroethyl) ether		ND	ND	ND	ND	ND		ND	
Benzene		370	NA	NA	NA	NA		570	
Carbon tetrachloride		ND	NA	220	310	ND		270	
Chloroform		74	NA	120	110	120		290	
1,1-Dichloroethane		ND	NA	ND	ND	ND		ND	
1,2-Dichloroethane		ND	NA	97	ND	ND		50	
1,1-Dichloroethylene		ND	NA	ND	ND	180		92	
Toluene		280	NA	NA	NA	NA		430	
Trichloroethylene		ND	NA	ND	ND	23		12	
1,1,1-Trichloroethane		ND	NA	130	140	39		160	
1,1,2-Trichloroethane		ND	NA	290	ND	ND		150	
Dichloromethane		ND	NA	>1,000	>1,000	>1,000		>1,600	
Semivolatile and Nonvolatile Organics		XAD-Sample Train						XAD Blank	Emission Rate ^a ($\mu\text{g/s}$)
● <u>RCRA Appendix VIII</u>									
Phenol		8,000						ND	8.0
1,3-Dichlorobenzene		11,800						ND	12
Naphthalene		9,400						2,700	6.7
Diethylphthalate		33,000						2,000	31
Dibutylphthalate		14,000						6,400	7.6
Bis-2-ethylhexylphthalate		719,000						155,000	560
● <u>Others</u>									
Phenanthrene		1,500						ND	1.5
Aliphatic hydrocarbon ^f		184,000						85,000	100
Alicyclic oxygen hydrocarbon ^f		85,000						44,000	41
Ethylbenzaldehyde ^g		36,000						ND	36
Benzoic acid ^g		56,000						33,000	23
Aromatic oxygen hydrocarbons ^f		18,000						ND	18
Hexadecanoic acid ^g		42,000						12,000	30
Molecular sulfur (S6-S8) ^g		108,000						ND	108
Bis(chlorobenzene)sulfone ^g		288,000						ND	290
Silicone ^f		41,000						63,000	--

^aEmissions are blank corrected^bTenax traps for this run could not be analyzed because of desorption problems^cBased on results from the second trap only. First trap resulted in desorption problems^dTraps for this run showed possible desorption problems^eTenax blank sample was not available for this test^fConcentration calculated using phenol-d₅ peak height^gConcentration calculated using naphthalene-d₈

ND - Not detected, detection limit 20 ng for volatile organics and 1,000 to 5,000 ng for semivolatile organics

NA - Compound not analyzed in the sample

TABLE 95. ORGANIC EMISSIONS, TEST 4 (COFIRING WITH SOLVENT NO. 3) -- SITE D

Compound	Sample Concentration, ng						Emission Rate ^e (ug/s)	
Volatile Organics: (RCRA Appendix VIII)	Tenax Traps			Impinger				Tenax ^d Blank
	Run 1 ^a	Run 2 ^b	Run 3 ^c	Run 1	Run 2	Run 3		
Tetrachloroethylene		64	40	420	840	330	880	
Bis(2-chloroethyl) ether	ND	ND	ND	ND	ND	ND	--	
Benzene	ND	ND	290	NA	NA	NA	220	
Carbon tetrachloride	ND	ND	ND	ND	ND	ND	--	
Chloroform	ND	ND	ND	64	94	77	120	
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	--	
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	--	
1,1-Dichloroethylene	ND	ND	ND	190	220	290	350	
Toluene	580	390	NA	NA	NA	NA	740	
Trichloroethylene	ND	ND	ND	ND	50	ND	25	
1,1,1-Trichloroethane	ND	ND	ND	50	140	ND	140	
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	--	
Dichloromethane	ND	5,900	>1,000	>1,000	>1,000	>1,000	>6,000	
Semivolatile and Nonvolatile Organics	XAD-Sample Train						XAD Blank	Emission Rate ^e (ug/s)
• <u>RCRA Appendix VIII</u>								
Phenol	8,000						ND	8.0
Bis(2-chloroethyl) ether	7,200						ND	7.4
Phenol	8,100						ND	8.3
1,3-Dichlorobenzene	9,500						ND	9.7
1,4-Dichlorobenzene	7,100						ND	7.3
Naphthalene	15,000						2,700	13
Diethylphthalate	1,900						2,000	--
Dibutylphthalate	12,000						6,400	5.7
Butylbenzylphthalate	9,900						8,200	1.7
Bis-2-ethylhexylphthalate	164,000						155,000	9.2
• <u>Others</u>								
Aliphatic hydrocarbon ^f	49,000						85,000	--
Alicyclic oxygen hydrocarbon ^f	153,000						44,000	110
Ethylbenzaldehyde ^g	52,000						ND	53
Benzoic acid ^g	110,000						33,000	79
Aromatic oxygen hydrocarbons ^f	31,000						ND	32
Hexadecanoic acid ^g	25,000						12,000	13
Molecular sulfur (S6-S8) ^g	91,000						ND	93
Aliphatic acid ^f	88,000						ND	90
Silicone ^f	37,000						63,000	--

^aData lost during analysis^bResults based only on analysis of first trap. Second trap was not heated to temperature during desorption^cResults are based on analysis of second trap only. First trap was not desorbed at temperature.^dAnalysis is not available because of broken trap^eEmissions are blank corrected^fConcentration calculated using phenol-d₅ peak height^gConcentration calculated using naphthalene-d₈

ND - Not detected, detection limit 20 ng for volatile organics and 1,000 to 5,000 ng for semivolatile organics

NA - Compound not analyzed in the sample

TABLE 96. ORGANIC EMISSIONS, TEST 5 (COFIRING WITH SOLVENT NO. 6) -- SITE D

Compound	Sample Concentration, ng						Emission Rate ^c ($\mu\text{g/s}$)	
Volatile Organics: (RCRA Appendix VIII)	Tenax Traps			Impinger				Tenax Blank
	Run 1 ^a	Run 2 ^b	Run 3 ^a	Run 1	Run 2	Run 3		
Tetrachloroethylene	30		68	140	560	780	22	590
Bis(2-chloroethyl) ether	ND		ND	ND	ND	ND	ND	ND
Benzene	220		ND	NA	NA	NA	360	ND
Carbon tetrachloride	ND		ND	ND	ND	ND	ND	ND
Chloroform	54		520	130	71	130	32	410
1,1-Dichloroethane	ND		ND	70	ND	ND	ND	26
1,2-Dichloroethane	ND		ND	ND	ND	ND	ND	ND
1,1-Dichloroethylene	ND		ND	59	71	210	ND	130
Toluene	300		ND	NA	NA	NA	800	ND
Trichloroethylene	ND		ND	18	21	ND	ND	15
1,1,1-Trichloroethane	ND		ND	120	76	94	60	110
1,1,2-Trichloroethane	ND		ND	ND	ND	ND	ND	ND
Dichloromethane	1,200		ND	>1,000	>1,000	>1,000	ND	>1,800
Semivolatile and Nonvolatile Organics								Emission Rate ^c ($\mu\text{g/s}$)
XAD-Sample Train								XAD Blank
● RCRA Appendix VIII								
Bis(2-chloroethyl) ether								ND
Phenol								4,900
Diethylphthalate								3,100
Dibutylphthalate								16,000
Bis-2-ethylhexylphthalate								228,000
● Others								
Aliphatic hydrocarbon ^d								40,000
Alicyclic oxygen hydrocarbon ^d								91,000
Ethylbenzaldehyde ^e								31,000
Benzoic acid ^c								54,000
Alkyl benzoic acid ^e								41,000
Aromatic oxygen hydrocarbons ^d								20,000
Hexadecanoic acid ^e								70,000
Molecular sulfur (S6-S8) ^e								58,000
Aliphatic acid ^e								220,000
Silicone ^d								29,000

^aRun 1 and run 3 Tenax traps emissions are each based on analysis of the second Tenax trap only. First trap in each run resulted in analytical problems

^bAnalyses of run 2 Tenax traps was not possible due to loss of sample

^cEmissions are blank corrected

^dConcentration calculated using phenol-d₅ peak height

^eConcentration calculated using naphthalene-d₈

ND - Not detected, detection limit 20 ng for volatile organics and 1,000 to 5,000 ng for semivolatile organics

NA - Compound not analyzed in the sample

TABLE 97. ORGANIC EMISSIONS, TEST 6 (COFIRING WITH SOLVENT NO. 6) -- SITE D

Compound	Sample Concentration, ng							
Volatile Organics: (RCRA Appendix VIII)	Tenax Traps			Impinger			Tenax Blank	Emission Rate ^c (µg/s)
	Run 1 ^a	Run 2 ^b	Run 3	Run 1	Run 2	Run 3		
	Tetrachloroethylene		71	112	950	390	520	16
Bis(2-chloroethyl) ether		ND	ND	ND	ND	ND	ND	ND
Benzene		64	53	NA	NA	NA	NA	50
Carbon tetrachloride		ND	ND	330	ND	ND	NA	94
Chloroform		130	ND	120	66	260	NA	160
1,1-Dichloroethane		ND	ND	ND	ND	ND	NA	ND
1,2-Dichloroethane		ND	ND	ND	ND	ND	NA	ND
1,1-Dichloroethylene		ND	ND	120	ND	250	NA	110
Toluene		1,000	670	NA	NA	NA	NA	720
Trichloroethylene		ND	ND	30	31	37	NA	28
1,1,1-Trichloroethane		57	ND	280	100	230	NA	200
1,1,2-Trichloroethane		ND	ND	ND	140	ND	NA	47
Dichloromethane		ND	ND	>1,000	>1,000	>1,000	NA	>860
Semivolatile and Nonvolatile Organics	XAD-Sample Train						XAD Blank	Emission Rate ^c (µg/s)
● <u>RCRA Appendix VIII</u>								
Bis(2-chloroethyl) ether	4,200						ND	4.2
Phenol	7,100						ND	7.1
Naphthalene	7,900						2,700	7.9
Diethylphthalate	11,000						2,000	9.0
Dibutylphthalate	14,000						6,400	7.6
Bis-2-ethylhexylphthalate	217,000						155,000	62
Benzo(a)anthracene	3,100						ND	3.1
● <u>Others</u>								
Aliphatic hydrocarbons ^d	85,000						85,000	--
Alicyclic oxygen hydrocarbons ^d	54,000						44,000	10
Ethylbenzaldehyde ^e	29,000						ND	29
Benzoic acid ^e	48,000						33,000	15
Alkyl benzoic acid ^e	25,000						11,000	14
Aromatic oxygen hydrocarbons ^d	30,000						ND	30
Aliphatic acid ^e	140,000						ND	140
Hexadecanoic acid ^e	28,000						ND	28
Molecular sulfur (S6-S8) ^e	48,000						12,000	36
Silicone ^d	32,000						64,000	--

^aAnalytical problems prevented analysis of run 1 Tenax traps^bRun 2 results are based on analysis of the first trap. Analysis of second trap was not possible because of analytical problems^cEmissions are blank corrected^dConcentration calculated using phenol-d₅ peak height^eConcentration calculated using naphthalene-d₈

ND - Not detected, detection limit 20 ng for volatile organics and 1,000 to 5,000 ng for semivolatile organics

NA - Compound not analyzed in the sample

TABLE 98. ORGANIC EMISSIONS, TEST 7 (COFIRING WITH SOLVENT NO. 6) -- SITE D

Compound	Sample Concentration, ng							Emission Rate ^c ($\mu\text{g/s}$)
Volatile Organics: (RCRA Appendix VIII)	Tenax Traps			Impinger ^a			Tenax Blank	
	Run 1 ^b	Run 2	Run 3 ^b	Run 1	Run 2	Run 3		
Tetrachloroethylene	32	120	110				41	50
Bis(2-chloroethyl) ether	ND	ND	22				ND	7.8
Benzene	43	320	49				NA	150
Chloroform	380	210	ND				NA	210
1,2-Dichloroethylene	ND	48	ND				NA	17
1,1,1-Trichloroethane	ND	130	ND				NA	46
Toluene	480	2,100	980				NA	1,300
Semivolatile and Nonvolatile Organics	XAD-Sample Train						XAD Blank	Emission Rate ^c ($\mu\text{g/s}$)
• <u>RCRA Appendix VIII</u>								
Bis(2-chloroethyl) ether	4,200						ND	4.2
Bis(2-chloroethyl) ether	7,000						ND	6.8
Phenol	8,800						ND	8.6
Naphthalene	8,100						ND	7.9
Diethylphthalate	26,000						2,000	23
Dibutylphthalate	10,000						6,400	3.5
2-Chlorophenol	9,100						ND	8.9
1,3-Dichlorobenzene	6,200						ND	6.1
Bis-2-ethylhexylphthalate	343,000						155,000	180
• <u>Others</u>								
Phenanthrene	1,100						ND	1.1
Di-n-octylphthalate	9,600						ND	9.4
Aliphatic hydrocarbon ^d	84,000						85,000	--
Alicyclic oxygen hydrocarbon ^d	79,000						44,000	34
Ethylbenzaldehyde ^e	37,000						ND	36
Benzoic acid ^e	63,000						33,000	29
Alkyl benzoic acid ^e	35,000						11,000	23
Aromatic oxygen hydrocarbons ^d	61,000						ND	60
Aliphatic acid ^e	22,000						ND	22
Hexadecanoic acid ^e	38,000						12,000	25
Molecular sulfur (S6-S8) ^e	120,000						ND	120
Silicone ^d	36,000						63,000	--

^aImpinger condensates were not available for this test

^bResults for runs 1 and 3 are based on analysis of one trap only. Second traps could not be desorbed properly

^cEmissions are blank corrected

^dConcentration calculated using phenol-d₅ peak height

^eConcentration calculated using naphthalene-d₈

ND - Not detected, detection limit 20 ng for volatile organics and 1,000 to 5,000 ng for semivolatile organics

NA - Compound not analyzed in the sample

TABLE 99. PIC'S EMISSIONS^a -- SITE D

Compound	Waste Solvent Stream No. 3 (PCE) Tests 2, 3, and 4			Waste Solvent Stream No. 6 (BCEE) Tests 5, 6, and 7		
	ppb	µg/dscm	µg/s	ppb	µg/dscm	µg/s
Carbon tetrachloride	0 to 4	0 to 30	0 to 270	0 to 2	0 to 15	0 to 94
Chloroform	2 to 6	13 to 31	120 to 290	5 to 12	26 to 67	160 to 410
2-Chlorophenol	ND	ND	ND	0 to 0.3	0 to 2	0 to 9
1,1-Dichloroethane	ND	ND	ND	0 to 1	0 to 4	0 to 26
1,2-Dichloroethane	0 to 2	0 to 7	0 to 64	ND	ND	ND
1,1-Dichloroethylene	2 to 9	10 to 40	92 to 360	0.8 to 5	3 to 20	17 to 130
Dichloromethane	>45	>170	>1,600	>36	>140	>860
Tetrachloroethylene	b	b	b	8	64	400
1,1,2-Trichloroethane	0 to 3	0 to 16	0 to 150	0 to 1	0 to 8	0 to 47

^aCompounds listed are all chlorinated organics whose concentration was greater than that measured during the baseline test

^bPCE is listed as a POHC for these tests

TABLE 100. FUEL COMPOSITIONS -- SITE D

Composition (percent by weight)	No. 6 Oil Tests 1 through 7	Solvent Stream No. 3			Solvent Stream No. 6		
		Test 2	Test 3	Test 4	Test 5	Test 6	Test 7
C	87.94	25.7 ^a	31.1 ^a	27.8 ^a	82.50	81.49	85.18
H	11.30	1.8 ^a	9.0 ^a	7.5 ^a	9.10	9.02	9.57
N	0.29	0.51 ^a	0.7 ^a	0.7 ^a	0.48	0.72	0.43
S	0.30	0.02	0.02	0.09	0.01	0.01	0.01
Cl	0.03	22.0	22.0	3.9	1.57	2.45	2.19
O (by difference)	--	NA ^b	NA ^b	NA ^b	6.13	6.11	2.53
Ash	0.05	0.11	0.17	0.10	0.02	<0.01	<0.01
Moisture	0.18	0.68	7.80	11.25	0.20	0.20	0.09
Gross heating value, Btu/lb	18,537	12,645	12,551	8,866	17,977	16,669	17,063
kcal/g	10.3	7.0	7.0	4.9	10.0	9.3	9.5

^aSignificant losses observed in carbon, hydrogen, and nitrogen^bNA -- No accurate oxygen was possible

TABLE 101. POHC CONCENTRATIONS IN WASTE SOLVENTS^a, mg/ml -- SITE D

Test No.	Composite ^b Sample	PCE Solvent Stream No. 3	BCEE Solvent Stream No. 6	Test Average Concentration
2	AM	284 - 292 (288)	--	295
	PM	305 - 297 (301)		
3	AM	272 - 269 (271)	--	163
	PM	55.0 - 53.3 (54.2)		
4	AM	45.6 - 43.4 (44.5)	--	69.6
	PM	95.0 - 94.3 (94.7)		
5	AM	--	39.5 - 41.3 (40.4)	41.0
	PM		41.5 - 41.5 (41.5)	
6	AM	--	39.3 - 41.5 (40.4)	40.2
	PM		39.3 - 40.7 (40.0)	
7	AM	--	40.2 - 39.8 (40.0)	40.2
	PM		40.7 - 39.9 (40.3)	

^aAll samples analyzed in duplicate. Numbers in parentheses represent the arithmetic average of duplicate analyses.

^bTwo separate waste solvent samples were available per test. These are distinguished between morning (AM) and afternoon (PM) samples corresponding to respective times when collected.

5.5 SITE E

TABLE 102. C₁ TO C₆ GASENOUS HYDROCARBON EMISSIONS, ppm -- SITE E

Test No.	Time Sample Was Taken	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆ +	Total C ₁ to C ₆
1	1010	--	0.3	--	0.3	--	--	0.6
	1430	--	1.8	4.0	1.3	53.3	12.1	72.5
	(average)	--	(1.1)	(2.0)	(0.8)	(27.7)	(6.1)	(36.6)
2	1000	--	--	1.4	1.9	134.2	184.6	322.1
	1405	--	--	--	0.3	11.6	20.5	32.4
	1540	--	--	1.0	1.2	26.3	43.5	72.0
	(average)	--	--	(1.2)	(1.1)	(57.4)	(82.9)	(142.2)
3	920	--	0.8	0.6	1.4	36.7	34.1	73.6
	1305	--	0.2	2.7	1.8	59.2	44.1	108.0
	(average)	--	(0.5)	(1.7)	(1.6)	(48.0)	(39.1)	(90.8)
4	930	--	--	--	0.5	25.0	33.1	58.6
	1240	--	--	--	0.3	11.3	4.7	16.3
	(average)	--	--	--	(0.4)	(18.2)	(18.9)	(37.5)
5	1025	--	--	--	--	69.6	130.1	199.7
	1253	--	--	4.6	1.6	46.7	34.4	87.3
	(average)	--	--	(2.3)	(0.8)	(58.2)	(82.3)	(143.5)
6	913	--	--	1.8	--	26.7	--	28.5
	1302	--	--	0.4	--	25.2	1.8	27.4
	(average)	--	--	(1.1)	--	(26.0)	(0.9)	(28.0)
7	930	--	--	1.2	--	13.2	16.5	30.9
	1350	--	--	0.4	--	6.8	9.9	17.1
	(average)	--	--	(0.8)	--	(10.0)	(13.2)	(24.0)
8	933	--	0.7	1.0	4.1	68.6	35.5	109.9
	1255	--	0.3	1.9	1.3	57.4	39.1	97.3
	(average)	--	(0.5)	(1.5)	(2.7)	(63.0)	(37.3)	(103.6)
9	905	--	--	0.9	0.9	19.7	30.0	51.5
	1316	--	--	0.2	0.4	39.2	20.9	60.7
	(average)	--	--	(0.6)	(0.7)	(29.5)	(25.5)	(56.1)

-- Indicates concentration was below the detection limit

TABLE 103. SULFUR BALANCE -- SITE E

Test Number	Sulfur Concentration (percent)		Sulfur ^a Input as SO ₂ ng/J	Average SO ₂ Emissions		Sulfur Closure Out/In (percent)
	Primary Fuel	Waste Fuel		ppm dry at 3 percent O ₂	ng/J	
1	0.55	0	254	276	216	85
2	0.55	0.01	200	196	153	77
3	0.55	0.01	184	182	142	77
4	0.55	0.01	182	184	143	79
5	0.55	0.08	200	205	162	81
6	0.55	0.02	153	198	153	100
7	0.55	0.03	209	234	184	88
8	0 ^b	0.01	0.06	35	27	45,000
9	0 ^b	0.03	0.28	17	13	4,600

^aBased on 100 percent conversion of fuel sulfur to SO₂

^bAssumes no sulfur present in the natural gas

TABLE 104. FUEL ASH CONTRIBUTION TO PARTICULATE EMISSIONS -- SITE E

Test No.	Ash Input, 10 ⁻³ kg/s (lb/hr)			Total Particulate Emissions 10 ⁻³ kg/s (lb/hr)	Measured Particulate Emissions (percent)	
	From Primary Fuel ^a	From Waste Fuel	Total		Inorganic Ash ^b	Organic Soot ^b
1	0.251 (1.99)	--	0.251 (1.99)	0.304 (2.41)	83	17
2	0.218 (1.73)	0.019 (0.15)	0.237 (1.88)	0.323 (2.56)	73	27
3	0.172 (1.36)	0.115 (0.91)	0.286 (2.27)	0.408 (3.23)	70	30
4	0.183 (1.45)	0.076 (0.60)	0.259 (2.05)	0.336 (2.66)	77	23
5	0.174 (1.38)	0.073 (0.58)	0.247 (1.96)	0.332 (2.55)	77	23
6	0.105 (0.83)	0.050 (0.40)	0.155 (1.23)	0.245 (1.94)	63	37
7	0.300 (2.38)	0.048 (0.38)	0.348 (2.76)	1.01 (7.94)	35	65
8	--	0.050 (0.40)	0.050 (0.40)	0.091 (0.718)	56	44
9	--	<0.023 (<0.18)	<0.023 (<0.18)	0.223 (1.77)	--	100

^aNo. 6 oil for tests 1 through 7 and natural gas for tests 8 and 9

^bThe distribution of total particulate between inorganic and organic matter assumes that no particulate matter is trapped in the boiler convective passes or flue gas ducts

TABLE 105. CHLORIDE (HCl) EMISSION RATES -- SITE E

Test No.	Run	Reagent Final Volume (ml)	Chloride Concentration (mg/l)	Total Chloride (mg)	Gas Volume Sampled Nm ³ (dscf)	Flue Gas ^a Flowrate Nm ³ /s (dscfm)	Chloride (HCl) Emissions	
							10 ⁻³ kg/s (lb/hr)	ng/J (lb/10 ⁶ Btu)
1	A ^b	460	15	7.0	36.4	7.15 (15,150)	0.05 (0.4)	2.32 (0.005)
	B	395	98	39	1.04 (36.7)		0.27 (2.1)	12.2 (0.028)
2	A	305	<2	<0.8	1.04 (36.9)	8.09 (17,140)	ND	ND
	B	420	60	25	1.05 (37.2)		0.19 (1.5)	7.87 (0.018)
3	A	460	1,800	850	1.05 (37.0)	8.24 (17,460)	6.68 (53.0)	324 (0.753)
4	A	450	1,700	780	1.06 (37.4)	8.84 (18,740)	6.51 (51.6)	292 (0.679)
5	A	460	2,100	960	1.05 (37.2)	8.85 18,760	8.07 (64.0)	384 (0.894)
	B	395	1,200	450	0.53 (18.8)		7.49 (59.4)	357 (0.830)
6	A	420	3,800	1,600	1.03 (36.5)	6.41 (13,580)	9.93 (78.7)	636 (1.48)
	B	530	2,400	1,300	0.68 (24.0)		12.3 (97.2)	786 (1.83)
7	A	430	1,800	760	1.04 (36.6)	12.5 (26,540)	9.18 (72.8)	285 (0.662)
	B	415	1,200	490	0.69 (24.3)		8.92 (70.7)	276 (0.643)
8	A	480	2,400	1,200	1.03 (36.5)	8.02 (17,000)	9.32 (73.9)	474 (1.10)
	B	440	1,600	710	0.72 (25.5)		7.90 (62.6)	401 (0.933)
9	A	430	21	9	1.02 (36.1)	7.60 (16,100)	0.06 (0.5)	3.96 (0.009)
	B	395	3.6	1.4	0.44 (15.5)		0.03 (0.2)	1.58 (0.004)

^aFrom Modified EPA Method 5 measurements
^bProbable contamination of this gas sample
^cND = not detected

TABLE 106. CHLORIDE BALANCE -- SITE E

Test No.	Chloride Input, 10 ⁻³ kg/s (lb/hr) from		Chloride Output 10 ⁻³ kg/s (lb/hr)	Chloride Balance Out/In (percent) Based on	
	Ultimate Analysis ^a	GC/Hall Analysis ^{a,b}		Ultimate Analysis	GC/Hall Analysis
1	2.00 (15.9)	--	0.05 to 0.27 (0.4 to 2.1)	2.5 to 13	--
2	1.93 (15.3)	--	ND to 0.19 (ND to 1.5)	0 to 10	--
3	5.46 (43.3)	14.1 (112)	6.68 (53.0)	122	47
4	6.61 (52.4)	15.3 (121)	6.51 (51.6)	98	43
5	5.07 (40.2)	14.8 (117)	8.07 to 7.49 (64.0 to 59.4)	159 to 148	55 to 51
6	8.37 (66.4)	14.8 (117)	9.93 to 12.3 (78.7 to 97.2)	119 to 146	67 to 83
7	10.4 (82.7)	17.3 (137)	9.18 to 8.92 (72.8 to 70.7)	88 to 85	53 to 52
8	5.88 (46.6)	12.1 (96)	9.32 to 7.90 (73.9 to 62.6)	159 to 134	77 to 65
9	0.37 (2.9)	0.018 (0.14)	0.06 to 0.03 (0.5 to 0.2)	17 to 7	360 to 143

^aIncludes the chlorine contribution of primary and waste fuels^bFrom analyses of chlorinated POHC's in waste fuels presented in section 5

TABLE 107. SUMMARY OF DRE CALCULATIONS -- SITE E

Test Description	No. 6 Oil and TSB	No. 6 Oil and Chlorinated TSB						Natural Gas and Chlorinated TSB	Natural Gas and Toluene/MMA Mix
		Cofire Test 2	Cofire Test 3	Cofire Test 4	Cofire Test 5	Cofire Test 6a	Cofire Test 7b		
Carbon tetrachloride	NA	99.9995	99.9998	99.9997	99.9990	99.9996	99.9998	NA	NA
Chlorobenzene	NA	99.9995	99.9999	99.9993	99.998	99.9998	99.9994	NA	NA
Trichloroethylene	NA	99.998	99.9995	99.997	99.994	99.993	99.992	99.9995	99.9999
Methyl methacrylate	99.997	99.95	99.98	99.999	99.9999	99.9996	99.9998	99.9999	99.9999
Methoxy butanone	>99.9999	99.9999	99.999	99.999	99.999	99.999	99.999	99.999	99.999
Methyl methoxy butanone	>99.9999	99.998	99.998	99.998	99.998	99.998	99.998	99.998	99.998

aLow boiler load test

bHigh boiler load test

NA - Not applicable. Chlorinated compounds were not added to waste fuels during this test

TABLE 108. SUMMARY OF POHC EMISSION RATES, $\mu\text{g/s}$ -- SITE E

Test Description	No. 6 Oil and TSB	No. 6 Oil and Chlorinated TSB						Natural Gas and Chlorinated TSB	Natural Gas and Toluene/MMA Mix
	Test 2	Test 3	Test 4	Test 5	Test 6 ^a	Test 7 ^b	Test 8	Test 9 ^a	
Carbon tetrachloride (CCl ₄)	4.5 to 220 (77) ^c	ND to 84 (29)	1.3 to 27 (18)	ND to 64 (21)	66 to 81 (73)	ND to 97 (33)	5 to 20 (12)	13 to 18 (15)	
Chlorobenzene (Cl ϕ)	ND to 8.3 (2.8)	35 to 390 (190)	ND to 13 (4)	ND to 52 (29)	46 to 82 (64)	ND to 190 (63)	ND to 23 (7.7)	90 to 180 (130)	
Trichloroethylene (TCE)	7.3 to 110 (38)	73 to 240 (140)	22 to 46 (36)	30 to 59 (47)	16 to 81 (49)	120 to 680 (470)	11 to 58 (35)	73 to 160 (94)	
Methyl methacrylate (MMA)	150 to 250 (220)	280 to 8,300 (4,000)	17 to 4,100 (1,400)	94 to 770 (375)	220 to 1,200 (710)	ND to 1,400 (880)	110 to 1,900 (720)	ND to 280 (130)	

^aLower boiler load tests
^bHigher boiler load test
^cNumbers in parentheses are arithmetic averages of individual Tenax test runs. All emissions are blank corrected.

ND -- Usually signifies that blank value was greater than sample value in which case compound was determined to be at concentrations less than detection limit (5 to 10 ng per sample corresponding to 2 to 4 $\mu\text{g/s}$)

TABLE 109. ORGANIC EMISSIONS, TEST 1 (BASELINE NO. 6 FUEL ONLY) -- SITE E

Compound ^a	Sample Concentration (ng)								Average Emission Rate ^c (ug/s)
	Tenax Traps (A and B)			Impinger Condensate and Rinse			Tenax Blank	Impinger Blank	
	Run 1 ^b	Run 2	Run 3 ^b	Run 1 ^b	Run 2	Run 3 ^b			
Volatile Organics: ^d <u>RCRA Appendix VIII</u> Carbon tetrachloride Chlorobenzene Trichloroethylene Methyl methacrylate Tetrachloroethylene Toluene									
		ND 50 15 ND NA NA			ND 240 ND 1,500 1,100 5,800		ND ND 18 170 NA NA	ND ND ND ND 300 NA	ND 170 ND 870 460 3,400
Semivolatile and Nonvolatile Organics: <u>RCRA Appendix VIII</u> Methyl methacrylate Phenol Dibutyl phthalate Diethyl phthalate Bis(2-ethylhexyl)phthalate Chlorotoluene <u>Others</u> Methoxy butanone Methyl methoxy butanone Aliphatic hydrocarbons Dimethylpentanone Siloxane and derivative Phenylethanone Ethylbenzaldehyde Benzoic acid Ethylbenzoate	XAD-Sample Train						XAD-Blank	Emission Rate ^c (ug/s)	
	ND 5,000 11,000 4,000 15,000 25,000						ND ND 10,000 ND 60,000 ND	ND 5.0 1.0 4.0 ND 25	
	ND ND 100,000 25,000 120,000 25,000 40,000 35,000 20,000						ND ND ND ND ND ND ND ND ND	ND ND 100 25 120 25 40 35 20	

^aCompounds listed are only those detected in the samples. The six compounds of interest (CCl₄, Cl₂, TCE, MMA, MOB, and MEMOB) are always listed.

^bRuns 1 and 3 not taken during this test due to difficulties with Tenax sampling system.

^cAll emissions are blank corrected. Volatile organic emissions are arithmetic averages of data from three separate test runs.

^dOther volatile compounds including methylene chloride, trichlorofluoromethane, C₂-C₃ alkyl benzenes and unidentified alkanes were also detected in Tenax traps. Concentrations of these compounds were not quantified.

ND -- Not detected. Concentration less than 10 to 20 ng for volatile organics in Tenax traps; less than 1 to 10 ng/ml for purgeable organics in impinger solutions; and generally less than 1,000 to 5,000 ng for semivolatile and nonvolatile organics.

NA -- Not analyzed

TABLE 110. ORGANIC EMISSIONS, TEST 2 (NO. 6 OIL AND TSB WASTE FUEL -- SITE E

Compound ^a	Sample Concentration (ng)								Average Emission Rate ^b (µg/s)
	Tenax Traps (A and B)			Impinger Condensate and Rinse			Tenax Blank	Impinger Blank	
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3			
Volatile Organics:^c									
<u>RCRA Appendix VIII</u>									
Carbon tetrachloride	14	220	25	ND	310	ND	3	ND	77
Chlorobenzene	88	9	30	ND	ND	ND	68	ND	3
Trichloroethylene	30	270	16	ND	ND	ND	12	ND	38
Methyl methacrylate	694	440	688	ND	ND	ND	68	ND	220
1,1,1-Trichloroethane	114	NA	65	ND	620	ND	13	ND	280
Chloroform	123	NA	48	ND	200	ND	1	290	34
Tetrachloroethylene	1,680	NA	550	ND	2,400	1,300	54	300	1,050
1,1,2,2-Tetrachloroethane	ND	NA	ND	1,000	ND	ND	ND	ND	130
Toluene	2,740	NA	11,200	1,000	ND	3,500	186	ND	3,350
Benzene	235	NA	210	ND	ND	ND	34	ND	76
<u>Other</u>									
Ethylbenzene	284	NA	164	ND	ND	ND	ND	NA	90
Semivolatile and Nonvolatile Organics:									
<u>RCRA Appendix VIII</u>									
Methyl methacrylate									
Dibutyl phthalate									
Diethyl phthalate									
Bis(2-ethylhexyl)phthalate									
Fluoranthene									
<u>Others</u>									
Methoxy butanone									
Methyl methoxy butanone									
Pyrene									
Phenylethanone									
Ethylbenzaldehyde									
Cyclohexanol									
Methylpentanol									
Methylcyclohexane									
Cyclohexanone									
Benzaldehyde									
Chlorocyclohexanol									

^aCompounds listed are only those detected in the samples. The six compounds of interest (CCl₄, CCl₃, TCE, HMA, MOB, and MEMOB) are always listed.

^bAll emissions are blank corrected. Volatile organic emissions are arithmetic averages of data from three separate test runs.

^cOther volatile compounds including methylene chloride, trichlorofluoromethane, C₂-C₃ alkyl benzenes and unidentified alkanes were also detected in Tenax traps. Concentrations of these compounds were not quantified.

ND -- Not detected. Concentration less than 1 to 10 ng for volatile organics in Tenax traps; less than 1 to 10 ng/ml for purgeable organics in impinger solutions; and generally less than 1,000 to 5,000 ng for semivolatile and nonvolatile organics.

NA -- Not analyzed

TABLE 111. ORGANIC EMISSIONS, TEST 3 (NO. 6 OIL AND CHLORINATED TSB WASTE FUEL) -- SITE E

Compound ^a	Sample Concentration (ng)								Average Emission Rate ^b (µg/s)
	Tenax Traps (A and B)			Impinger Condensate and Rinse			Tenax Blank	Impinger Blank	
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3			
Volatile Organics:^c									
<u>RCRA Appendix VIII</u>									
Carbon tetrachloride	97	174	65	ND	120	ND	90	ND	29
Chlorobenzene	84	46	34	ND	290	910	ND	ND	190
Trichloroethylene	300	56	222	ND	140	380	18	ND	140
Methyl methacrylate	760	NA	550	7,300	680	19,500	NA	ND	4,000
Chloroform	NA	ND	NA	ND	210	340	ND	290	ND
Tetrachloroethylene	NA	ND	NA	1,100	2,030	1,400	ND	300	500
Benzene	NA	NA	NA	660	ND	660	NA	ND	180
Toluene	NA	NA	NA	4,700	3,600	810	NA	ND	1,300
Methylene chloride	NA	ND	NA	91,000	156,000	120,000	ND	ND	50,000
<u>Other</u>									
Ethylbenzene	NA	NA	NA	410	430	940	NA	ND	240
Semivolatile and Nonvolatile Organics:									
<u>RCRA Appendix VIII</u>									
XAD-Sample Train							XAD-Blank	Emission Rate ^b (µg/s)	
Methyl methacrylate	58,000						ND	58	
Phenol	13,000						ND	13	
Dibutyl phthalate	7,000						10,000	ND	
Bis(2-ethylhexyl)phthalate	60,000						60,000	ND	
Chlorobenzene	30,000						ND	30	
<u>Others</u>									
Methoxy butanone	120,000						ND	120	
Methyl methoxy butanone	280,000						ND	280	
Pyrene	1,000						ND	1.0	
Phenanthrene	17,000						ND	17	
Aliphatic hydrocarbons	80,000						ND	80	
Siloxane derivative	420,000						ND	420	
Chlorocyclohexanol	95,000						ND	95	
Molecular sulfur	60,000						ND	60	

^aCompounds listed are not to scale

^aCompounds listed are only those detected in the samples. The six compounds of interest (CCl₄, Cl₂, TCE, MMA, MOB, and MEMOB) are always listed.

^bAll emissions are blank corrected. Volatile organic emissions are arithmetic averages of data from three separate test runs.

^cOther volatile compounds including methylene chloride, trichlorofluoromethane, C₂-C₃ alkyl benzenes and unidentified alkanes were also detected in Tenax traps. Concentrations of these compounds were not quantified.

ND -- Not detected. Concentration less than 1 to 10 ng for volatile organics in Tenax traps; less than 1 to 10 ng/ml for purgeable organics in impinger solutions; and generally less than 1,000 to 5,000 ng for semivolatile and nonvolatile organics.

NA -- Not analyzed

TABLE 112. ORGANIC EMISSIONS, TEST 4 (NO. 6 OIL AND CHLORINATED TSB WASTE FUEL) -- SITE E

Compound ^a	Sample Concentration (ng)								Average Emission Rate ^b (ug/s)
	Tenax Traps (A and B)			Impinger Condensate and Rinse			Tenax Blank	Impinger Blank	
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3			
Volatile Organics:^c									
<u>RCRA Appendix VIII</u>									
Carbon tetrachloride	120	63	134	ND	ND	ND	60	ND	18
Chlorobenzene	91	51	136	ND	ND	ND	100	ND	4
Trichloroethylene	184	143	222	ND	ND	ND	93	ND	36
Methyl methacrylate	553	880	2,070	ND	ND	10,000	515	ND	1,400
Tetrachloroethylene	1,310	NA	2,530	ND	570	520	430	300	630
1,1,2,2-Tetrachloroethane	ND	NA	ND	ND	ND	520	ND	ND	70
Toluene	4,320	NA	4,170	1,500	ND	1,600	400	ND	2,000
Benzene	408	NA	577	ND	ND	ND	ND	NA	200
Chloroform	154	NA	237	ND	ND	ND	84	ND	45
1,1,1-Trichloroethane	244	NA	353	ND	ND	ND	170	ND	52
<u>Other</u>									
Ethylbenzene	1,400	NA	723	ND	NA	ND	89	NA	400
Methoxybutane	NA	NA	NA	ND	NA	780	ND	NA	160
Ethyl ester propanoic acid	NA	NA	NA	ND	NA	1,600	ND	NA	330
Chloromethylbenzene	NA	NA	NA	ND	NA	780	ND	NA	160
Semivolatile and Nonvolatile Organics:									
<u>RCRA Appendix VIII</u>									
Methyl methacrylate	XAD-Sample Train						XAD-Blank		Emission Rate ^b (ug/s)
	ND						ND		ND
Phenol	14,000						ND		14
Dibutyl phthalate	20,000						10,000		10
Bis(2-ethylhexyl)phthalate	42,000						60,000		ND
Fluoranthene	3,000						ND		3.0
Acenaphthalene	2,000						ND		2.0
Naphthalene	40,000						ND		40
<u>Others</u>									
Methoxy butanone	ND						ND		ND
Methyl methoxy butanone	200,000						ND		200
Siloxane derivative	300,000						ND		300
Ethylbenzaldehyde	30,000						ND		30
Dimethylhexanol	100,000						ND		100
Dichlorocyclohexanol	35,000						ND		35
Methylpropenylbenzene	35,000						ND		35
Trimethylcyclohexanone	50,000						ND		50
Octadecanoic acid	45,000						ND		45

^aCompounds listed are only those detected in the samples. The six compounds of interest (CCl₄, CCl₃, TCE, MMA, MOB, and MEMOB) are always listed.

^bAll emissions are blank corrected. Volatile organic emissions are arithmetic averages of data from three separate test runs.

^cOther volatile compounds including methylene chloride, trichlorofluoromethane, C₂-C₃ alkyl benzenes and unidentified alkanes were also detected in Tenax traps. Concentrations of these compounds were not quantified.

ND -- Not detected. Concentration less than 1 to 10 ng for volatile organics in Tenax traps; less than 1 to 10 ng/ml for purgeable organics in impinger solutions; and generally less than 1,000 to 5,000 ng for semivolatile and nonvolatile organics.

NA -- Not analyzed

TABLE 113. ORGANIC EMISSIONS, TEST 5 (NO. 6 OIL AND CHLORINATED TSB WASTE FUEL) -- SITE E

Compound ^a	Sample Concentration (ng)								Average Emission Rate ^b (ug/s)
	Tenax Traps (A and B)			Impinger Condensate and Rinse			Tenax Blank	Impinger Blank	
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3			
Volatile Organics:^c									
<u>RCRA Appendix VIII</u>									
Carbon tetrachloride	214	52	60	ND	ND	ND	70	ND	21
Chlorobenzene	142	43	177	ND	ND	ND	60	ND	29
Trichloroethylene	278	260	212	ND	ND	ND	145	ND	47
Methyl methacrylate	432	1,960	811	ND	ND	ND	220	ND	375
Tetrachloroethylene	2,360	1,120	3,090	ND	ND	950	390	300	800
Chloroform	338	182	317	ND	ND	ND	115	ND	73
Toluene	4,050	1,960	5,020	220	1,800	ND	320	ND	1,780
Benzene	875	500	762	ND	570	750	61	ND	480
1,1,1-Trichloroethane	535	256	328	ND	ND	300	15	ND	200
<u>Other</u>									
Chloromethylbenzene	NA	NA	ND	ND	380	380	NA	NA	110
Ethylbenzene	414	365	950	ND	290	300	82	NA	310
Methoxybutane	NA	NA	NA	170	ND	ND	ND	NA	25
Ethenyl ester prapanoic acid	NA	NA	NA	440	ND	ND	ND	NA	65
Oxybismethane	NA	NA	NA	660	ND	ND	ND	NA	97
Ethylmethylbenzene	NA	NA	NA	ND	290	380	ND	NA	100
Xylenes	NA	NA	NA	ND	290	380	ND	NA	100
Epoxymethyl pentane	NA	NA	NA	ND	860	ND	ND	NA	130
Semivolatile and Nonvolatile Organics:									
<u>RCRA Appendix VIII</u>									
Methyl methacrylate	ND						ND		ND
Dibutyl phthalate	5,000						10,000		ND
Diethylphthalate	5,000						ND		5.0
Bis(2-ethylhexyl)phthalate	117,000						60,000		120
Di-n-octylphthalate	10,000						ND		10
<u>Others</u>									
Methoxy butanone	ND						ND		ND
Methyl methoxy butanone	ND						ND		ND
Pyrene	1,000						ND		1.0
Ethylbenzaldehyde	20,000						ND		20
Cyclohexanol	60,000						ND		60
Chlorocyclohexanol	280,000						ND		280
Octobicycloheptane	30,000						ND		30
Chlorocyclohexane	40,000						ND		40
Bicyclohexenyl	50,000						ND		50
Molecular sulfur	10,000						ND		10
Hexadecanoic acid	35,000						ND		35

^aCompounds listed are only those detected in the samples. The six compounds of interest (CCl₄, Cl₂, TCE, MMA, MOB, and MEMOB) are always listed.

^bAll emissions are blank corrected. Volatile organic emissions are arithmetic averages of data from three separate test runs.

^cOther volatile compounds including methylene chloride, trichlorofluoromethane, C₂-C₃ alkyl benzenes and unidentified alkanes were also detected in Tenax traps. Concentrations of these compounds were not quantified.

ND -- Not detected. Concentration less than 1 to 10 ng for volatile organics in Tenax traps; less than 1 to 10 ng/ml for purgeable organics in impinger solutions; and generally less than 1,000 to 5,000 ng for semivolatile and nonvolatile organics.

NA -- Not analyzed

TABLE 114. ORGANIC EMISSIONS, TEST 6 (NO. 6 OIL AND CHLORINATED TSB WASTE FUEL) -- SITE E

Compound ^a	Sample Concentration (ng)								Average Emission Rate ^c (µg/s)
	Tenax Traps (A and B)			Impinger Condensate and Rinse			Tenax Blank	Impinger Blank	
	Run 1	Run 2 ^b	Run 3	Run 1	Run 2 ^c	Run 3			
Volatile Organics: ^d									
RCRA Appendix VIII									
Carbon Tetrachloride	165		178	ND		ND	ND	ND	73
Chlorobenzene	132		198	ND		ND	17	ND	64
Trichloroethylene	101		240	ND		ND	61	ND	49
Methyl methacrylate	726		2,820	ND		ND	166	ND	710
Tetrachloroethylene	1,740		2,040	ND		400	44	300	870
Toluene	4,610		4,550	440		320	200	ND	2,000
Benzene	690		1,160	180		ND	35	ND	410
1,1,1-Trichloroethane	230		491	ND		160	46	ND	170
Chloroform	159		655	ND		160	14	290	200
Other									
Ethylbenzene	968		915	ND		ND	69	ND	370
Chloromethylbenzene	NA		ND	ND		160	ND	NA	34
Ethenyl ester propanoic acid	NA		NA	790		ND	ND	NA	170
Oxybismethane	NA		NA	ND		320	ND	NA	68
3-Buten-2-ol	NA		NA	ND		640	ND	NA	140
Semivolatile and Nonvolatile Organics:									
RCRA Appendix VIII									
XAD-Sample Train									
XAD-Blank									
Emission Rate ^c (µg/s)									
Methyl methacrylate									
ND									
Dibutyl phthalate									
12,000									
Diethylphthalate									
4,000									
Bis(2-ethylhexyl)phthalate									
36,000									
Di-n-octylphthalate									
6,000									
Naphthalene									
7,000									
Others									
Methoxy butanone									
ND									
Methyl methoxy butanone									
59,000									
Phenanthrene									
8,000									
Siloxane derivative									
175,000									
Ethylbenzaldehyde									
40,000									
Chlorocyclohexanol									
140,000									
Methylpropenylbenzene									
40,000									
Trimethylchyclohexanone									
70,000									
Chlorocyclohexene									
120,000									
Bicyclohexenyl									
40,000									
Molecular sulfur									
60,000									
Methylpentanol									
80,000									
Trimethylnaphthalenylsilane									
20,000									

^aCompounds listed are only those detected in the samples. The six compounds of interest (CCl₄, C₁₀, TCE, MMA, MOB, and MEMOB) are always listed.

^bRun 2 Tenax train was not available due to sampling problems

^cAll emissions are blank corrected. Volatile organic emissions are arithmetic averages of data from three separate test runs.

^dOther volatile compounds including methylene chloride, trichlorofluoromethane, C₂-C₃ alkyl benzenes and unidentified alkanes were also detected in Tenax traps. Concentrations of these compounds were not quantified.

ND -- Not detected. Concentration less than 1 to 10 ng for volatile organics in Tenax traps; less than 1 to 10 ng/ml for purgeable organics in impinger solutions; and generally less than 1,000 to 5,000 ng for semivolatile and nonvolatile organics.

NA -- Not analyzed

TABLE 115. ORGANIC EMISSIONS, TEST 7 (NO 6 OIL AND CHLORINATED TSB WASTE FUEL) -- SITE E

Compound ^a	Sample Concentration (ng)								Average Emission Rate ^c (ug/s)
	Tenax Traps (A and B)			Impinger Condensate and Rinse			Tenax Blank	Impinger Blank	
	Run 1 ^b	Run 2	Run 3	Run 1	Run 2	Run 3			
Volatile Organics:^d									
<u>RCRA Appendix VIII</u>									
Carbon tetrachloride	ND	66	172	ND	ND	ND	62	ND	33
Chlorobenzene	25	81	367	ND	ND	ND	155	ND	63
Trichloroethylene	ND	326	416	780	ND	490	142	ND	470
Methyl methacrylate	89	2,840	2,420	ND	ND	ND	846	ND	880
Chloroform	ND	168	866	14,000	21,000	49,000	115	290	21,000
Tetrachloroethylene	257	1,400	5,030	10,000	ND	24,000	600	300	9,500
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	730	ND	ND	180
Toluene	1,440	2,690	8,700	23,000	6,300	7,800	600	ND	12,000
Benzene	51	710	1,900	5,900	2,300	3,600	59	ND	3,600
1,1,1-Trichloroethane	ND	326	491	1,800	ND	1,200	198	ND	800
<u>Other</u>									
Ethylbenzene	175	600	1,310	1,800	1,100	970	207	NA	1,330
Ethylmethylbenzene	NA	NA	NA	11,000	450	ND	ND	NA	2,900
Xylenes	NA	NA	NA	5,100	2,700	ND	ND	NA	1,950
Chloromethylbenzene	NA	NA	NA	2,300	1,400	ND	ND	NA	920
Trimethylbenzene	NA	NA	NA	ND	ND	49,000	ND	NA	12,000

Semivolatile and Nonvolatile Organics:	XAD-Sample Train						XAD-Blank		Emission Rate ^c (ug/s)
<u>RCRA Appendix VIII</u>									
Methyl methacrylate	ND						ND		ND
Phenol	6,000						ND		10
Dibutyl phthalate	21,000						10,000		18
Bis(2-ethylhexyl)phthalate	65,000						60,000		8.0
<u>Others</u>									
Methoxy butanone	ND						ND		ND
Methyl methoxy butanone	ND						ND		ND
Siloxane derivative	160,000						ND		260
Trimethylcyclohexanone	300,000						ND		480
Chlorocyclohexene	100,000						ND		160
Hexadecanoic acid	140,000						ND		230
Methyl-methyl ester-heptadecanoic acid	70,000						ND		110
	50,000						ND		80

^aCompounds listed are only those detected in the samples. The six compounds of interest (CCl₄, CCl₂, TCE, MMA, MOB, and MEMOB) are always listed.

^bMass spectrometry computer problem caused loss of A trap analytical results for this test run. Organic concentrations are based on B trap only (not included in average).

^cAll emissions are blank corrected. Volatile organic emissions are arithmetic averages from date of three separate test runs.

^dOther volatile compounds including methylene chloride, trichlorofluoromethane, C₂-C₃ alkyl benzenes and unidentified alkanes were also detected in Tenax traps. Concentrations of these compounds were not quantified.

ND - Not detected. Concentration less than 1 to 10 ng for volatile organics in Tenax traps; less than 1 to 10 ng/ml for purgeable organics in impinger solutions; and generally less than 1,000 to 5,000 ng for semivolatile and nonvolatile organics.

NA - Not analyzed

TABLE 116. ORGANIC EMISSIONS, TEST 8 (NATURAL GAS AND CHLORINATED TSB WASTE FUEL) -- SITE E

Compound ^a	Sample Concentration (ng)								Average Emission Rate ^c (ug/s)
	Tenax Traps (A and B)			Impinger Condensate and Rinse			Tenax Blank	Impinger Blank	
	Run 1 ^b	Run 2	Run 3	Run 1	Run 2	Run 3			
Volatile Organics:^d									
<u>RCRA Appendix VIII</u>									
Carbon tetrachloride	24	41	60	ND	ND	ND	11	ND	12
Chlorobenzene	58	38	107	ND	ND	ND	50	ND	7.7
Trichloroethylene	61	179	122	ND	ND	ND	33	ND	35
Methyl methacrylate	262	612	539	4,500	ND	ND	266	ND	720
Tetrachloroethylene	860	1,710	3,170	13,000	ND	ND	400	300	2,200
Toluene	3,400	2,710	4,110	6,900	14,000	4,100	393	ND	4,500
Benzene	400	445	610	2,000	3,100	550	103	ND	910
Chloroform	530	886	480	41,000	1,400	ND	77	290	5,800
1,1,1-Trichloroethane	120	286	365	ND	ND	ND	66	ND	77
Other									
Ethylbenzene	200	269	512	2,400	840	ND	105	NA	520
1,1-Diethoxyethane	NA	NA	NA	1,200	2,200	ND	ND	NA	450
Methoxy propanol	NA	NA	NA	ND	ND	55,000	ND	NA	7,400
Semivolatile and Nonvolatile Organics:									
<u>RCRA Appendix VIII</u>									
Methyl methacrylate	ND						ND		ND
Phenol	2,000						ND		1.4
Dibutylphthalate	10,000						10,000		ND
Bis(2-ethylhexyl)phthalate	96,000						60,000		26
<u>Others</u>									
Methoxy butanone	ND						ND		ND
Methyl methoxy butanone	38,000						ND		27
Phenanthrene	6,000						ND		4.3
Aliphatic hydrocarbon	310,000						ND		220
Ethylbenzoate	30,000						ND		21
Cyclohexanol	70,000						ND		50
Cyclohexanone	40,000						ND		28
Chlorocyclohexanol	300,000						ND		210
Chlorocyclohexene	80,000						ND		57
Trichloropropene	45,000						ND		32
Dichlorocyclohexane	45,000						ND		32

^aCompounds listed according to EPA Method 8260 and 8210.

^aCompounds listed are only those detected in the samples. The six compounds of interest (CCl₄, Cl₂, TCE, MMA, MOB, and MEMOB) are always listed.

^bMass spectrometry computer problems caused loss of A trap analytical data for this test run. Organic concentrations are based on B trap only (not included in average).

^cAll emissions are blank corrected. Volatile organic emissions are arithmetic averages of data from three separate test runs.

^dOther volatile compounds including methylene chloride, trichlorofluoromethane, C₂-C₃ alkyl benzenes and unidentified alkanes were also detected in Tenax traps. Concentrations of these compounds were not quantified.

ND -- Not detected. Concentration less than 1 to 10 ng for volatile organics in Tenax traps; less than 1 to 10 ng/ml for purgeable organics in impinger solutions; and generally less than 1,000 to 5,000 ng for semivolatile and nonvolatile organics.

NA -- Not analyzed

TABLE 117. ORGANIC EMISSIONS, TEST 9 (NATURAL GAS AND TOLUENE/MMA WASTE MIXTURE) -- SITE E

Compound ^a	Sample Concentration (ng)								Average Emission Rate ^b (µg/s)
	Tenax Traps (A and B)			Impinger Condensate and Rinse			Tenax Blank	Impinger Blank	
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3			
Volatile Organics:^c									
<u>RCRA Appendix VIII</u>									
Carbon tetrachloride	36	34	48	ND	ND	ND	ND	ND	15
Chlorobenzene	127	235	193	380	ND	160	27	ND	130
Trichloroethylene	119	192	94	380	ND	160	68	ND	94
Methyl methacrylate	492	ND	960	ND	ND	ND	220	ND	130
Chloroform	1,480	NA	1,395	16,000	9,400	4,300	NA	290	4,200
Tetrachloroethylene	2,960	NA	1,690	7,000	2,400	2,300	NA	300	2,000
Toluene	3,900	NA	4,510	19,000	3,100	7,700	NA	ND	5,400
Benzene	1,565	NA	206	3,200	630	1,400	NA	ND	1,000
1,1,1-Trichloroethane	207	NA	258	1,100	270	480	NA	ND	320
Chloromethane	ND	NA	ND	ND	540	ND	NA	ND	68
<u>Other</u>									
Ethylbenzene	446	NA	360	2,300	410	480	NA	NA	560
Ethylmethylbenzene	ND	NA	ND	8,600	1,300	4,000	NA	NA	1,800
Xylenes	ND	NA	ND	14,000	1,800	1,800	NA	NA	2,200
Trimethylbenzene	ND	NA	ND	2,700	ND	1,100	NA	NA	480
Semivolatile and Nonvolatile Organics:^c									
<u>RCRA Appendix VIII</u>									
Methyl methacrylate	ND						ND		ND
Bis(2-ethylhexyl)phthalate	1,430,000						ND		1,500
Di-n-octylphthalate	76,000						60,000		85
Naphthalene	30,000						ND		34
<u>Others</u>									
Methoxy butanone	ND						ND		ND
Methyl methoxy butanone	ND						ND		ND
Aliphatic hydrocarbon	160,000						ND		180
Benzoic acid	30,000						ND		34
Ethylbenzoate	30,000						ND		34

^aCompounds listed are only those detected in the samples. The six compounds of interest (CCl₄, CCl₃, TCE, MMA, MOB, and MEMOB) are always listed.

^bAll emissions are blank corrected. Volatile organic emissions are arithmetic averages of data from three separate test runs.

^cOther volatile compounds including methylene chloride, trichlorofluoromethane, C₂-C₃ alkyl benzenes and unidentified alkanes were also detected in Tenax traps. Concentrations of these compounds were not quantified.

ND -- Not detected. Concentration less than 1 to 10 ng for volatile organics in Tenax traps; less than 1 to 10 ng/ml for purgeable organics in impinger solutions; and generally less than 1,000 to 5,000 ng for semivolatile and nonvolatile organics.

NA -- Not analyzed

TABLE 118. OTHER VOLATILE ORGANIC EMISSIONS^a -- SITE E

Compound	Units	No. 6 Oil and TSB	No. 6 Oil and Chlorinated TSB					Natural Gas and Chlorinated TSB	Natural Gas and Toluene/MMA Mixture
		Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9
Chloroform	ug/s ug/dscm ppb	34 4.2 0.4	ND ND ND	45 5.1 0.5	73 8.2 0.7	200 31 2.8	21,000 1,700 150	5,800 720 65	4,200 550 50
1,1,1-Trichloroethane	ug/s ug/dscm ppb	280 35 2.8	ND ND ND	52 5.9 0.5	200 23 1.9	170 27 2.2	800 64 5.2	77 9.6 0.8	320 42 3.4
1,1,2,2-Tetrachloroethane	ug/s ug/dscm ppb	130 16 1.0	ND ND ND	70 7.9 0.5	ND ND ND	ND ND ND	180 14 0.9	ND ND ND	ND ND ND
Tetrachloroethylene	ug/s ug/dscm ppb	1,050 130 8.5	500 61 4.0	630 71 4.6	800 90 5.9	870 140 9.1	9,500 760 50	2,200 270 18	2,000 260 17
Toluene	ug/s ug/dscm ppb	3,350 410 48	1,300 160 19	2,000 230 27	1,780 200 23	2,000 310 36	12,000 960 110	4,500 560 66	5,400 710 83
Benzene	ug/s ug/dscm ppb	76 9.4 1.3	180 22 3.0	200 23 3.2	480 54 7.5	410 64 8.9	3,600 290 40	910 110 15	1,000 130 18
Chlorinated methane	ug/s ug/dscm ppb	ND ND ND	50,000 ^b 6,100 780	ND ND ND	ND ND ND	ND ND ND	ND ND ND	ND ND ND	68 ^c 9.0 1.9

^aAverage test emissions^bMethylene chloride; this compound was also identified in Tenax traps of several other tests but concentrations were not quantified.^cChloromethane

TABLE 119. CARBON TETRACHLORIDE DRE CALCULATIONS -- SITE E

Test No.	Input Rate (million $\mu\text{g/s}$)	Emission Rate ^a ($\mu\text{g/s}$)	DRE (percent)	Average Test DRE Percent
3	6.55	2.9 84 ND	99.99996 99.998 >99.9999	99.9995
4	7.48	27 1.3 26	99.9996 99.99998 99.9996	99.9998
5	7.29	64 ND ND	99.9991 >99.9999 >99.9999	99.9997
6 ^b	7.62	66 NA 81	99.9991 NA 99.9990	99.9990
7 ^c	8.34	ND 2.5 97	>99.9999 99.99997 99.998	99.9996
8 ^d	6.79	5.2 12 20	99.99992 99.9998 99.9997	99.9998
Average for all tests	7.35	29	99.9996	

^aEmissions are for each individual test run. All emissions are corrected for blank values.

^bLow load test

^cHigh load test

^dCofiring with natural gas. All other tests cofiring with no. 6 oil.

ND -- Generally indicates that blank value was greater than sample

NA -- Not available

TABLE 120. CHLOROBENZENE (C1 ϕ) DRE CALCULATIONS -- SITE E

Test No.	Input Rate (million $\mu\text{g/s}$)	Emission Rate ^a ($\mu\text{g/s}$)	DRE (percent)	Average Test DRE Percent
3	3.90	35 140 390	99.9991 99.996 99.990	99.995
4	4.14	ND ND 13	>99.9999 >99.9999 99.9997	99.9999
5	4.03	36 ND 52	99.9991 >99.9999 99.998	99.9993
6 ^b	4.69	46 NA 82	99.9990 NA 99.998	99.998
7 ^c	4.77	ND ND 190	>99.9999 >99.9999 99.996	99.998
8 ^d	3.66	ND ND 23	>99.9999 >99.9999 99.9994	99.9998
Average for all tests	4.20	59	99.998	

^aEmissions are for each individual test run. All emissions are corrected for blank values.

^bLow load test

^cHigh load test

^dCofiring with natural gas. All other tests cofiring with no. 6 oil.

ND -- Generally indicates that blank value was greater than sample

NA -- Not available

TABLE 121. TRICHLOROETHYLENE (TCE) DRE CALCULATIONS -- SITE E

Test No.	Input Rate (million µg/s)	Emission Rate ^a (µg/s)	DRE (percent)	Average Test DRE Percent
3	6.79	120 73 240	99.998 99.999 99.996	99.998
4	7.66	40 22 46	99.9995 99.9997 99.9994	99.9995
5	7.24	59 51 30	99.9992 99.9993 99.996	99.9994
6 ^b	7.36	16 NA 81	99.9998 NA 99.9990	99.9993
7 ^c	7.74	610 120 680	99.992 99.998 99.991	99.994
8 ^d	6.03	11 58 36	99.9998 99.9990 99.9994	99.9994
Average for all tests	7.14	135	99.998	

^aEmissions are for each individual test run. All emissions are corrected for blank values.

^bLow load test

^cHigh load test

^dCofiring with natural gas. All other tests cofiring with no. 6 oil.

ND -- Generally indicates that blank value was greater than sample

NA -- Not available

TABLE 122. METHYL METHACRYLATE (MMA) DRE CALCULATIONS -- SITE E

Test No.	Input Rate (million $\mu\text{g/s}$)	Emission Rate ^a ($\mu\text{g/s}$)	DRE (percent)	Average Test DRE Percent
2	6.67	250 150 250	99.996 99.998 99.996	99.997
3	8.87	3,300 280 8,300	99.96 99.997 99.90	99.95
4	8.60	17 160 4,100	99.9998 99.998 99.95	99.98
5	12.45	94 770 260	99.9992 99.994 99.998	99.997
6 ^b	12.09	220 NA 1,200	99.998 NA 99.990	99.994
7 ^c	11.82	ND 1,250 1,400	>99.9999 99.989 99.988	99.993
8 ^d	9.44	1,900 140 110	99.98 99.998 99.999	99.992
9 ^{b,d}	27.76	100 ND 280	99.9996 >99.9999 99.9990	99.9995
Average for all tests	12.21	1,100	99.991	

^aEmissions are for each individual test run. All emissions are corrected for blank values.

^bLow load tests

^cHigh load test

^dCofiring with natural gas. All other tests cofiring with no. 6 oil.

ND -- Generally indicates that blank value was greater than sample

NA -- Not available

TABLE 123. METHOXY BUTARATE (MOB) DRE CALCULATIONS -- SITE E

Test No.	Input Rate (million $\mu\text{g/s}$)	Emission Rate ^a ($\mu\text{g/s}$)	DRE (percent)
2	69.81	ND	>99.9999
3	105.5	120	99.9999
4	98.22	ND	>99.9999
5	83.15	ND	>99.9999
6 ^b	75.92	ND	>99.9999
7 ^c	73.44	ND	>99.9999
8 ^d	86.55	ND	>99.9999
9 ^{b,d}	4.78	ND	>99.9999
Average for all tests	74.67	15	>99.9999

^aEmissions are for each individual test run. All emissions are corrected for blank values.

^bLow load tests

^cHigh load test

^dCofiring with natural gas. All other tests cofiring with no. 6 oil.

ND -- Generally indicates that blank value was greater than sample

NA -- Not available

TABLE 124. METHYL METHOXY BUTARATE (MEMOB) DRE CALCULATIONS -- SITE E

Test No.	Input Rate (million $\mu\text{g/s}$)	Emission Rate ^a ($\mu\text{g/s}$)	DRE (percent)
2	14.04	ND	>99.9999
3	19.92	280	99.998
4	18.45	200	99.998
5	16.05	ND	>99.9999
6 ^b	13.61	58	99.9996
7 ^c	14.39	ND	>99.9999
8 ^d	21.30	27	99.9998
9 ^{b,d}	1.56	ND	>99.9999
Average for all tests	14.92	70	>99.9995

^aEmissions are for each individual test run. All emissions are corrected for blank values.

^bLow load tests

^cHigh load test

^dCofiring with natural gas. All other tests cofiring with no. 6 oil.

ND -- Generally indicates that blank value was greater than sample

NA -- Not available

TABLE 125. FUEL COMPOSITIONS -- SITE E

Composition (percent by weight)	No. 6 Oil Test 1 Through 7	TSB Test 2	TSB + C1 Mix (CCl ₄ , Cl Φ , TCE)						Toluene + MMA Test 9
			Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	
C	86.64	59.90	57.67	56.06	54.11	55.45	55.99	57.21	77.02
H	12.06	8.56	8.53	8.00	8.02	8.27	7.91	8.54	9.02
N	0.34	2.06	2.50	2.70	2.21	2.47	3.00	2.05	1.05
S	0.55	0.01	0.01	0.01	0.08	0.02	0.03	0.01	0.03
Cl	0.40	0.10	1.80	2.06	1.53	3.00	3.35	2.36	0.16
O (by difference)	0	27.63	25.46	28.46	31.45	28.29	27.29	28.48	12.52
Ash	0.05	0.01	0.05	0.03	0.03	0.02	0.02	0.02	<0.01
Moisture	0.2	1.73	3.98	2.71	2.57	2.50	2.41	1.33	0.20
Gross Heating Value Btu/lb	18,657	11,741	10,975	11,108	10,546	11,245	11,076	11,491	15,941
kcal/g	10.37	6.52	6.10	6.17	5.86	6.25	6.15	6.38	8.86

TABLE 126. WASTE FUEL ANALYSIS RESULTS^a, mg/m³ -- SITE E

Compound	Waste Fuel Description								
	TSB	Chlorinated TSB							Toluene/MMA Mixture
		Cofiring Test 2	Cofiring Test 3	Cofiring Test 4	Cofiring Test 5	Cofiring Test 6	Cofiring Test 7	Cofiring Test 8	Cofiring Test 9
CCl ₄ ^b	ND		27.1 to 28.2 (27.7)	28.3 to 29.1 (28.7)	30.3 to 27.9 (29.1)	28.5 to 29.6 (29.1)	34.4 to 32.3 (33.4)	26.5 to 27.3 (26.9)	0.08 to 0.09 (0.09)
C1 ₂ ^b	ND		16.7 to 16.2 (16.5)	16.0 to 15.8 (15.9)	15.6 to 16.6 (16.1)	17.5 to 18.2 (17.9)	19.5 to 18.7 (19.1)	14.4 to 14.5 (14.5)	ND
TCE ^b	ND		29.1 to 28.3 (28.7)	29.7 to 29.1 (29.4)	29.7 to 28.1 (28.9)	27.2 to 28.9 (28.1)	32.2 to 29.8 (31.0)	23.9 to 23.9 (23.9)	0.08 to 0.09 (0.09)
MMA ^b	31.5 to 36.6 (34.1)		38.2 to 36.8 (37.5)	33.0 to 32.9 (33.0)	47.6 to 51.8 (49.7)	44.0 to 48.3 (46.2)	45.3 to 49.3 (47.3)	38.9 to 35.9 (37.4)	107 to 131 (119)
MOB	336 to 378 (357)		450 to 441 (446)	336 to 388 (377)	321 to 343 (332)	275 to 305 (290)	283 to 304 (294)	366 to 320 (343)	13.9 to 27.0 (20.5)
MENOB	70.0 to 73.6 (71.8)		82.7 to 85.6 (84.2)	69.4 to 72.1 (70.8)	61.3 to 66.8 (64.1)	49.9 to 54.0 (52.0)	54.1 to 61.1 (57.6)	89.3 to 79.4 (84.4)	7.3 to 6.1 (6.7)

ND - Not detected (concentration is below detection limit)

^aAll samples analyzed in duplicate. Numbers in parentheses represent the arithmetic average of duplicate analysis.^bPOHC's per RCRA Appendix VIII list (May 1980)

5.6 SITE F

TABLE 127. SUMMARY OF PARTICULATE CATCHES AND EMISSIONS -- SITE F

Test	Particulate Catches (mg)			Total Emissions		
	Probe and Nozzle	Filter	Total	g/dscm (gr/dscf)	ng/J (lb/million Btu)	g/s (lb/hr)
1	45.7	107.3	153	0.0176 (0.0070)	7.61 (0.0177)	0.0807 (0.640)
2	96.8	535.5	632.3	0.0755 (0.0328)	36.5 (0.0848)	0.363 (2.88)
3	80.9	719.4	800.3	0.0876 (0.0380)	41.1 (0.0956)	0.423 (3.37)
4	117.5	712.3	829.8	0.0973 (0.0422)	44.7 (0.1039)	0.438 (3.47)

TABLE 128. FUEL ASH CONTRIBUTION TO PARTICULATE EMISSIONS -- SITE F

Test	Ash Input g/s (lb/hr)			Total Particulate Emissions, g/s (lb/hr)
	From Oil	From Thinner	Total	
1	0.0738 (0.585)	-- --	0.0738 (0.585)	0.0807 (0.64)
2	0.0631 (0.500)	0.325 (2.58)	0.388 (3.08)	0.363 (2.88)
3	0.0646 (0.512)	0.349 (2.77)	0.414 (3.28)	0.423 (3.37)
4	0.0618 (0.490)	0.288 (2.28)	0.350 (2.77)	0.438 (3.47)

TABLE 129. CHLORIDE EMISSIONS -- SITE F

Test	Run	Reagent Final Volume (ml)	Chloride Concentration (mg/l)	Total Chloride (mg) ^a	Gas Volume Sample Nm ³ (dscf)	Flue Gas Flowrate ^b Nm ³ /s (dscfm)	Chloride Emissions g/s (lb/hr)
1	A	405	180	71	0.422 (14.7)	4.587 (9,720)	0.772 (5.73)
	B	345	<2	<0.7	0.416 (14.71)	4.587 (9,720)	<0.008 (<0.0063)
2	A	330	240	78.5	0.415 (14.65)	4.805 (10,182)	0.909 (7.21)
	B	350	370	129	0.596 (21.03)	4.805 (10,182)	1.04 (8.25)
3	A	425	490	207	0.439 (15.5)	4.847 (10,271)	2.29 (18.2)
	B	535	810	433	0.641 (22.65)	4.847 (10,271)	3.27 (25.9)
4	A	490	1,300	636	0.579 (20.45)	4.504 (9,543)	4.95 (39.2)
	B	542	910	493	0.468 (16.54)	4.504 (9,543)	4.75 (37.6)

^aBlank corrected^bFrom modified EPA Method 5 measurement

TABLE 130. POHC FLOWRATES AND DRE'S OF RCRA APPENDIX VIII COMPOUNDS --
SITE F

Flowrates (ug/s)	Trichloroethylene	Chlorobenzene	Carbon Tetrachloride	Toluene
Baseline emissions test 1 ^a	102	7.4	29.6	128
Cofire test 2				
Input	205,000	33,900	547,000	268,000
Emissions run 1 ^b	--c	>13.8	>33.1	>328
run 2	106	25.1	136	421
run 3	20.5	1.86	60.3	72
Cofire test 3				
Input	1,690,000	194,000	1,034,000	410,000
Emissions run 1 ^d	>84.8	>16.2	>23.8	>132
run 2	40.1	20.4	25.6	121
run 3 ^e	195	10.8	1,430	92.6
Cofire test 4				
Input	1,400,000	99,400	837,000	131,000
Emissions run 1	25.8	13.7	14.7	29.1
run 2	30.4	12.4	4.31	41.1
DRE's (percent)				
Test 2 run 1 ^b	--c	<99.96	<99.994	<99.88
run 2	99.95	99.93	99.98	99.8
run 3	99.990	99.995	99.990	99.97
Test 3 run 1 ^d	<99.995	<99.992	<99.999	<99.97
run 2	99.998	99.989	99.9998	99.97
run 3 ^e	99.988	99.994	99.86	99.98
Test 4 run 1	99.998	99.986	99.998	99.98
run 2	<u>99.998</u>	<u>99.988</u>	<u>99.9995</u>	<u>99.97</u>
Weighted average DRE	99.996	99.987	99.995 ^f	99.95

^aBased on emissions from one test run only

^bTenax trap used for method development. Results based on Tenax/charcoal trap only.

^cNo emission estimation possible

^dTenax/charcoal trap lost. Results based on Tenax trap only.

^eLow recovery of quantification standard, emissions may be high and DRE may be low

^fTest 3, run 3 results were disregarded in calculating weighted average DRE

TABLE 131. SUMMARY OF BLANK CORRECTED DRE'S -- SITE F

Compound	Test 2 (percent)			Test 3a (percent)			Test 4 (percent)	
	Run 1b	Run 2	Run 3	Run 1c	Run 2	Run 3	Run 1	Run 2
<u>RCRA Appendix VIII</u>								
Trichloroethylene	--d	99.95	99.991	<99.995	99.998	99.989	99.9988	99.998
Chlorobenzene	<99.96	99.93	99.995	<99.992	99.990	99.95	99.998	99.988
Carbon tetrachloride	<99.996	99.98	99.992	<99.997	99.997	99.86	99.998	>99.9999e
Toluene	<99.88	99.8	99.98	<99.97	99.97	99.98	99.968	99.97
<u>Other</u>								
Ethylbenzene	<99.93	99.8	99.94	99.997	99.997	99.998	99.95	99.94

aCorrected using average of blank values for tests 2 and 4 due to high blank

bBased on results of Tenax/charcoal trap only

cBased on results of Tenax trap only

dNo emissions estimate possible

eGreater-than values (>) indicate that the blank concentration was higher than the sample concentration

TABLE 132. VOLATILE ORGANIC EMISSIONS, BASELINE -- SITE F

Compound	VOST Sample Concentration (ng)	Emission Rate ^a (µg/s)
<u>RCRA Appendix VIII</u>		
Dichloromethane	7,600	1,900
Chloroform	1,920	490
1,2-dichloroethane	34	8.7
1,2-dichloropropane	11	2.8
Trichloroethylene	398	102
1,1,1-trichloroethane	294	75.1
Benzene	4,850	1,240
Toluene	500	128
Chlorobenzene	29	7.4
t-1,2-dichloroethylene	50	13
Chloromethane	210	54
Vinylchloride	37	9.5
Chloroethane	160	41
Bromomethane	23	5.9
t-1,3-dichloropropene	1,030	263
Trichlorofluoromethane	26,300	6,720
Carbon tetrachloride	116	29.6
cis-1,3-dichloropropene	102	26.1
Dichlorobromomethane	14	3.6
<u>Other</u>		
Ethylbenzene	83	21

^aOnly one test run was performed during the baseline test

TABLE 133. SEMIVOLATILE ORGANIC EMISSIONS, BASELINE -- SITE F

Compound	XAD Sample Train (µg)	XAD Blank (µg)	Emission Rate (µg/s)
<u>RCRA Appendix VIII</u>			
Phenol	6	ND ^a	3.4
Naphthalene	7	2	4.5
Diethylphthalate	2	ND	1.1
Bis(2-ethylhexyl)phthalate	63	241	--
<u>Other</u>			
5-ethyldihydrofuranone	80	ND	46
1-ethenyl-4-ethylbenzene	110	ND	63
Ethylbenzaldehyde	60	ND	34
Benzoic acid	35	ND	20
1,3-isobenzofurandione	50	ND	28
Dimethylpentanol	15	ND	8.5

^aND = Not detected

TABLE 134. VOLATILE ORGANIC EMISSIONS, TEST 2 -- SITE F

Compound	Sample Concentration (ng)			Sample Field Blank (ng)	Emission Rate (ug/s) ^b		
	Run 1 ^a	Run 2	Run 3		Run 1 ^a	Run 2	Run 3
<u>RCRA Appendix VIII</u>							
Dichloromethane	>1,500	6,500	2,185	2,380	>397	1,730	583
Chloroform	>320	890	4,808	420	>84.8	236	1,280
1,2-dichloroethane	-- ^c	31	114	142	--	8.21	30.4
1,2-dichloropropane	--	18	19	--	--	4.77	5.06
Trichloroethylene	--	400	77	4	--	106	20.5
1,1,1-trichloroethane	>63	231	640	25	>16.7	61.4	171
Benzene	>4,600	5,045	5,115	151	>1,220	1,340	1,360
Bromoform	--	--	250	--	--	--	66.7
Tetrachloroethylene	--	--	22	--	--	--	5.86
Toluene	>1,240	1,590	270	67	>328	421	72
Chlorobenzene	>52	94	7	3	>13.8	25.1	1.86
trans 1,2-dichloroethylene	>48	115	99	30	>12.7	30.5	26.4
1,1,2,2-tetrachloroethane	>340	73	90	--	>90.1	19.4	24.0
Chloromethane	>2,300	4,200	2,624	710	>609	1,120	700
Vinylchloride	>440	49	31	--	>117	13.0	8.28
Chloroethane	>190	16	13	--	>50.3	4.24	3.47
Bromomethane	>60	49	20	23	>15.9	13.0	5.33
trans 1,3-dichloropropene	>550	--	106	1,400	>146	--	28.3
Trichlorofluoromethane	>19,000	20,500	12,900	7,800	>5,030	5,450	3,440
Carbon tetrachloride	>125	510	226	9	>33.1	136	60.3
cis 1,3-dichloropropene	--	--	4	52	--	--	1.06
Dichlorobromomethane	--	26	--	--	--	6.89	--
<u>Other</u>							
Ethylbenzene	80	142	27	17	>21.2	37.6	7.19

^aTenax trap used for methods development. Data is presented for Tenax/charcoal trap only. This is reflected by use of the ">" sign in the emissions.

^bEmissions are not blank corrected

^cDashes indicate that that compound was not detected in the analysis -- detection limits were generally 10 ng

TABLE 135. SEMIVOLATILE ORGANIC EMISSIONS, TEST 2 -- SITE F

Compound	XAD Sample Train ($\mu\text{g}/\text{dscm}$)	Emission Rate ($\mu\text{g}/\text{s}$)
<u>RCRA Appendix VIII</u>		
Phenol	0.48	2.3
Naphthalene	0.84	4.0
Diethylphthalate	0.60	2.9
Dibutylphthalate	0.60	2.9
<u>Other</u>		
5-ethyldihydrofuranone	2.4	12
1-ethenyl,4-ethylbenzene	4.2	20
Ethylbenzaldehyde	6.0	29
Benzoic acid	7.2	35
1,3-isobenzofurandione	7.2	35
Benzaldehyde	3.6	17
Methyldodecanol	2.4	12
1-phenylethanone	3.6	17
Dimethylbenzaldehyde	2.4	12
Ethylbenzoic acid	1.2	5.8
1,1-dimethylethylbenzenediol	6.0	29
Sulfur (elemental)	6.0	29
Methylheptadecanoic acid methylester	1.2	5.8

TABLE 136. VOLATILE ORGANIC EMISSIONS, TEST 3 -- SITE F

Compound	Sample Concentration (ng)			Sample Field Blank (ng)	Emission Rate (ug/s) ^a		
	Run 1 ^b	Run 2	Run 3 ^c		Run 1 ^b	Run 2	Run 3 ^c
<u>RCRA Appendix VIII</u>							
Dichloromethane	>1,000	>5,000	70,176	1,820	>265	1,346	18,886
Chloroform	>93	840	73,000	4,350	>24.6	226	19,650
1,2-dichloroethane	>32	369	520	1,330	>8.47	99.3	140
1,2-dichloropropane	>14	-- ^d	--	30	>3.69	--	--
Trichloroethylene	>320	149	725	82	>84.8	40.1	195
1,1,1-trichloroethane	>165	160	10,000	460	>43.7	43.1	2,691
Benzene	>1,530	1,495	895	227	>405	402	241
Tetrachloroethylene	--	--	37	--	--	--	9.94
Toluene	>500	450	344	219	>132	121	92.6
Chlorobenzene	>61	76	40	36	>16.2	20.4	10.8
trans 1,2-dichloroethylene	>21	83	192	185	>5.56	22.3	51.7
1,1,2,2-tetrachloroethane	>56	--	--	42	>14.8	--	--
Chloromethane	>170	326	16,023	1,500	>45.0	87.8	4,311
Vinylchloride	>7	570	16	16	>1.86	153	4.31
Chloroethane	>10	268	10	33	>2.64	72.1	2.69
Bromomethane	>7	5	--	24	>1.86	1.33	--
trans 1,3-dichloropropene	--	31	--	2,500	--	8.33	--
Trichlorofluoromethane	>370	5,150	5,042	22,300	>98	1,386	1,357
Carbon tetrachloride	>90	95	5,315	350	>23.8	25.6	1,431
cis-1,3-dichloropropene	--	--	5	--	--	--	1.33
Dichlorobromomethane	--	--	5,400	34	--	--	1,453
<u>Other</u>							
Ethylbenzene	>41	35	22	37	>10.9	9.42	5.92

^aEmissions are not blank corrected^bData presented for the Tenax trap only. This is reflected by use of the ">" sign in the emissions.^cEmissions during this test run are considered suspect because of poor recovery of internal standards in Tenax samples^dDashes indicate that that compound was not detected in the analysis -- detection limits were generally 10 ng

TABLE 137. SEMIVOLATILE ORGANIC EMISSIONS, TEST 3 -- SITE F

Compound	XAD Sample Train ($\mu\text{g}/\text{dscm}$)	Emission Rate ($\mu\text{g}/\text{s}$)
<u>RCRA Appendix VIII</u>		
Phenol	0.33	1.6
Naphthalene	0.66	3.2
Diethylphthalate	0.22	1.1
Bis(2-ethylhexyl)phthalate	11.9	58
<u>Other</u>		
Ethylbenzaldehyde	4.9	24
Benzoic acid	16	78
1,3-isobenzofurandione	5.5	27
Methyldodecanol	3.3	16
1-phenylethanone	3.3	16
Ethylbenzoic acid	2.2	11
Sulfur (elemental)	11	53
Dimethylbenzene	2.2	11
Trimethylbenzene	2.2	11
Butane dioic acid dimethylester	2.2	11
Methylpropylbenzene	3.3	16
Ethylmethylbenzene	1.1	5.3
Pentane dioic acid dimethylester	1.1	5.3
Hexadecanoic acid	2.2	11

TABLE 138. VOLATILE ORGANIC EMISSIONS, TEST 4 -- SITE F

Compound	Sample Concentration (ng)		Sample Field Blank (ng)	Emission Rate ^a (µg/s)	
	Run 1 ^b	Run 2		Run 1	Run 2
<u>RCRA Appendix VIII</u>					
Dichloromethane	925	2,980	710	234	758
Chloroform	104	25	733	26.3	6.33
1,2-dichloroethane	13	33	--	3.28	8.36
1,2-dichloropropane	8	12	--	2.03	3.06
Trichloroethylene	102	120	24	25.8	30.4
1,1,1-trichloroethane	55	103	120	13.9	26.1
Benzene	614	913	25	155	231
Tetrachloroethylene	3	8	--	0.75	2.03
Toluene	115	162	52	29.1	41.1
Chlorobenzene	54	49	--	13.7	12.4
1,1-dichloroethylene	12	4	--	3.06	1.00
trans 1,2-dichloroethylene	-- ^c	6	42	--	1.53
Chloromethane	278	1,950	32	70.4	494
Vinylchloride	43	--	15	10.9	--
Chloroethane	28	34	28	7.08	8.61
Bromomethane	--	12	12	--	3.06
trans 1,3-dichloropropene	--	360	114	--	91.3
Trichlorofluoromethane	730	115	2,050	185	29.1
Carbon tetrachloride	58	17	67	14.7	4.31
<u>Other</u>					
Ethylbenzene	25	30	15	6.3	7.6

^aEmissions are not blank corrected^bOnly two test runs were performed during this test^cDashes indicate that that compound was not detected in the analysis -- detection limits were generally 10 ng

TABLE 139. SEMIVOLATILE ORGANIC EMISSIONS, TEST 4 -- SITE F

Compound	XAD Sample Train ($\mu\text{g}/\text{dscm}$)	Emission Rate ($\mu\text{g}/\text{s}$)
<u>RCRA Appendix VIII</u>		
Phenol	1.8	8.1
Naphthalene	1.4	6.3
Diethylphthalate	0.23	1.0
2,4-dimethylphenol	7.3	33
Bis(2-chloroisopropyl)ether	1.5	68
<u>Other</u>		
Ethylbenzaldehyde	9.4	42
Benzoic acid	23	104
Benzaldehyde	5.9	27
1-phenylethanone	5.9	27
Dimethylbenzaldehyde	5.9	27
Benzene dicarboxylic acid	12	54
Sulfur (elemental)	12	54
Chlorocyclohexanol	19	86

TABLE 140. OTHER ORGANIC EMISSIONS LISTED IN RCRA APPENDIX VIII -- SITE F

Compounds	Emission Rate ^a			
	Test 1 Baseline	Test 2 Cofire	Test 3 ^b Cofire	Test 4 Cofire
<u>Volatile Organics</u>				
Dichloromethane	1,900	903	6,830	496
Chloroform	490	534	6,630	16.3
1,2-dichloroethane	8.7	13	82.6	5.8
1,2-dichloropropane	2.8	3.3	1.2	1.5
1,1,1-trichloroethane	75.1	83	926	20
Benzene	1,240	1,310	349	193
Bromoform	ND	22	ND	ND
Tetrachloroethylene	ND	1.9	3.3	1.4
1,1-dichloroethylene	ND	ND	ND	2.0
Trans-1,2-dichloroethylene	13	23.2	26.5	0.76
1,1,2,2-tetrachloroethane	ND	44.5	5.0	ND
Chloromethane	54	810	1,481	282
Vinyl chloride	9.5	43.1	53	5.5
Chloroethane	41	19.3	26	7.8
Bromomethane	5.9	11.4	1.1	1.5
Trans-1,3-dichloropropene	263	58.1	2.8	45.6
Trichlorofluoromethane	6,720	4,640	947	107
Cis-1,3-dichloropropene	26.1	0.3	0.4	ND
Dichlorobromomethane	3.6	2.3	484	ND
<u>Semivolatile and Nonvolatile Organics</u>				
Phenol	3.4	2.3	1.6	8.1
Naphthalene	4.5	4.0	3.2	6.3
Diethyl phthalate	1.1	2.9	1.1	1.0
Dibutyl phthalate	ND	2.9	ND	ND
Bis(2-ethylhexyl)phthalate	ND	ND	58	ND
2,4-Dimethyl phenol	ND	ND	ND	33
Bis(2-chloroisopropyl)ether	ND	ND	ND	68

^aAverage of each test in µg/s^bLow recovery of quantification standard for volatile organics. Emission rates presented may be high.

TABLE 141. TCE DRE RESULTS -- SITE F

Cofiring Test No.	Feedrate (10 ³ µg/s)	Run No.	Emission Rate (µg/s)	DRE ^a (percent)	Test Average DRE (percent)
2	205	1 2 3	ND ^b 106 20.5	>99.997 99.95 99.990	99.98
3	1,690	1 2 3	>84.8 40.1 195 ^c	99.995 99.998 99.988	99.994
4	1,400	1 2	25.8 30.4	99.998 99.998	99.998
Weighted average DRE (percent)	3,300	--	134	99.996	--

^aDRE's are based on emission rates not corrected for sample field blanks

^bND -- Not detected

^cEmissions are considered suspect because of poor recovery of internal standards during laboratory analysis of the samples. Not used in computing weighted average DRE.

TABLE 142. C1 ϕ DRE RESULTS -- SITE F

Cofiring Test No.	Feedrate (10 ³ μ g/s)	Run No.	Emission Rate (μ g/s)	DRE ^a (percent)	Test Average DRE (percent)
2	33.9	1 2 3	>13.8 25.1 1.86	<99.96 99.93 99.995	99.96
3	194	1 2 3	>16.2 20.4 10.8 ^b	<99.992 99.989 99.994	99.992
4	99.4	1 2	13.7 12.4	99.986 99.988	99.987
Weighted average DRE (percent)	327	--	42.4	99.987	--

^aDRE's are based on emission rates not corrected for sample field blanks

^bEmissions are considered suspect because of poor recovery of internal standards during laboratory analysis of the samples

TABLE 143. CC14 DRE RESULTS -- SITE F

Cofiring Test No.	Feedrate (10 ³ µg/s)	Run No.	Emission Rate (µg/s)	DRE ^a (percent)	Test Average DRE (percent)
2	547	1 2 3	>33.1 136 60.3	<99.994 99.98 99.990	99.98
3	1,034	1 2 3	>23.8 25.6 1,430 ^b	<99.998 99.998 99.86	99.998
4	837	1 2	14.7 4.31	99.998 99.9995	99.999
Weighted average DRE (percent)	2,418	--	111	99.995	--

^aDRE's are based on emission rates not corrected for sample field blanks

^bEmissions are considered suspect because of poor recovery of internal standards during laboratory analysis of the samples

TABLE 144. TOLUENE DRE RESULTS -- SITE F

Cofiring Test No.	Feedrate (10 ³ µg/s)	Run No.	Emission Rate (µg/s)	DRE ^a (percent)	Test Average DRE (percent)
2	268	1 2 3	>328 421 72	<99.88 99.8 99.97	99.90
3	410	1 2 3	>132 121 92.6 ^b	<99.97 99.97 99.98	99.97
4	131	1 2	29.1 41.1	99.98 99.97	99.97
Weighted average DRE (percent)	809	--	435	99.95	--

^aDRE's are based on emission rates not corrected for sample field blanks

^bEmissions are considered suspect because of poor recovery of internal standards during laboratory analysis of the samples

TABLE 145. FUEL ANALYSIS -- SITE F

Composition (percent by weight)	No. 6 Fuel Oil	Unspiked Thinner	Test 2 Spiked Thinner		Test 3 Spiked Thinner	Test 4 Spiked Thinner	
			A ^a	B ^b		A ^b	B ^a
C	86.80	67.15	67.79	66.76	65.64	63.73	64.85
H	10.67	10.00	10.64	10.40	10.02	9.81	9.84
N ^c	0.41	2.09	1.07	0.67	0.58	0.82	0.60
S	0.87	<0.05	<0.05	<0.05	<0.05	<0.05	0.20
Cl ^c	0.12	0.22	1.68 ^d	1.82	4.18	6.95	5.86
O (by difference)	1.03	18.07	16.94	18.88	18.07	17.09	17.37
Ash	0.03	2.26	1.44	1.02	1.07	1.15	0.83
Moisture	0.07	0.21	0.44	0.45	0.44	0.45	0.45
Gross heating value							
kJ/kg	43,580	33,421	33,243	33,505	32,006	31,765	30,309
(Btu/lb)	(18,751)	(14,380)	(14,303)	(14,416)	(13,771)	(13,662)	(13,041)
Specific gravity	0.9795	0.9377	0.9313	0.9317	0.9426	0.9580	0.9493

^aTaken during the VOST run^bTaken during the nonVOST half of the day^cAverage of three measurements^dAverage of two measurements, third measurement low by a factor of two

TABLE 146. VOLATILE ORGANIC COMPOSITION OF THINNER, g/l -- SITE F

Compound	Unspiked Thinner	Test			
		2 ^a	3	4	4 ^a
<u>RCRA Appendix VIII</u>					
Carbon tetrachloride ^b	<1	20.8	29.8	30.0	29.5
Trichloroethylene ^b	<1	7.8	48.6	61.4	49.2
Chlorobenzene ^b	<1	1.29	5.6	5.8	3.5
Toluene	13.75	10.2	11.8	8.7	4.6
<u>Other</u>					
Ethylbenzene	<1	0.9	1.05	0.7	0.46

^aTaken during VOST run^bAdded to the thinner for purposes of this test

5.7 SITE G

TABLE 147. C₁ to C₆ GASEOUS HYDROCARBON EMISSIONS^a -- SITE G

Test Number	Time Sample Was Taken	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	Total C ₁ to C ₆
1	1815	11.0	3.3	-- ^b	0.46	--	--	14.8
	1910	8.9	--	7.1	0.92	--	--	16.9
	(average)	10.0	1.7	3.6	0.69	--	--	16.0
2	1050	4.0	--	3.0	--	--	--	7.0
	1314	2.6	--	4.3	--	--	--	6.9
	1645	4.6	--	3.2	--	--	--	7.8
	(average)	3.7	--	3.5	--	--	--	7.2
3	942	4.2	--	2.8	--	--	--	7.0
	1314	5.6	--	3.5	--	--	--	9.1
	1415	8.2	--	7.1	--	--	--	15
	(average)	6.0	--	4.5	--	--	--	11
Test program average		6.1	0.41	3.9	0.17	--	--	11

^aparts per million as measured^bIndicates concentration was less than the detection limit

TABLE 148. MASS FLOWRATES OF ORGANICS IN MAKEUP WATER AND RECOVERY SCRUBBER DISCHARGE STREAMS, $\mu\text{g/s}^a$ -- SITE G

Compound	Makeup Water (In)	Recovery Scrubber Discharge (Out)	(Out-In)
Methylene chloride	180 to 710 ^b (360)	5.4 to 7,000 (2,500)	2,600
Chloroform	250 to 410 (320)	ND ^c to 5.4 (1.8)	-320
1,2-Dichloroethane	ND	ND to 16 (5.4)	6.5
Carbon tetrachloride	ND	ND	--
Bromodichloromethane	120 to 210 (160)	ND to 16 (9.1)	-150
Trans-1,3-dichloropropylene	6.5 to 32 (19)	ND	-19
Trichloroethylene	ND	ND to 5.4 (1.8)	2.2
Chlorodibromomethane	45 to 590 (230)	ND to 166 (108)	-100
Bromoform	ND to 1,230 (420)	ND to 540 (190)	-90
Chlorobenzene	ND	ND to 10 (3.4)	4.1

^aOrganic specie flowrates are based on stream flowrates of 5.2 l/s (83 gpm)

^bRanges in flowrates are based on analytical results of each test. Number in parentheses represents the arithmetic average of the range given.

^cNot detected. Less than 6 $\mu\text{g/s}$.

TABLE 149. MASS FLOWRATES OF ORGANICS IN MAKEUP WATER AND HCl SCRUBBER DISCHARGE STREAMS, $\mu\text{g/s}^a$ -- SITE G

Compound	Makeup Water (In)	HCl Scrubber Discharge (Out)	(Out-In)
Methylene chloride	280 to 1,100 ^b (570)	320 to 570 (430)	-60
Chloroform	380 to 630 (500)	220 to 280 (250)	-250
1,2-Dichloroethane	ND ^c	ND	
Carbon tetrachloride	ND	ND to 30 (10)	10
Bromodichloromethane	190 to 330 (250)	850 to 1,000 (920)	670
Trans-1,3-dichloropropylene	10 to 50 (30)	ND to 70 (23)	-7
Trichloroethylene	ND	ND to 40 (13)	13
Chlorodibromomethane	70 to 920 (360)	2,400 to 3,700 (3,100)	2,700
Bromoform	ND to 1,900 (660)	2,800 to 4,400 (3,300)	2,600
Chlorobenzene	ND	ND to 50 (16)	16

^aOrganic specie flowrates are based on stream flowrates of 10 l/s (160 gpm)

^bRanges in flowrates are based on analytical results of each test. Number in parentheses represents the arithmetic average of the range given.

^cNot detected. Less than 10 $\mu\text{g/s}$.

Table 150. OTHER THROX FEED ORGANIC DRE'S

Compound	Average Feed Rate ($10^6 \mu\text{g/s}$)	Average Emission Rate ($\mu\text{g/s}$)	DRE (percent)
1-Chloro-2-propanol	64.1 ^a	<2	>>99.9999
Trans-1,3-dichloropropylene	31.6 ^b	<2	>>99.9999
Epichlorohydrin	40.4	<2	>>99.9999
Bis(2-chloroisopropyl)ether	107	<0.4 ^c	>>99.9999

^aBased on 67 percent of combined 1-chloro-2-propanol and t-1,3-dichloropropylene concentration

^bBased on 33 percent of combined 1-chloro-2-propanol and t-1,3-dichloropropylene concentration

^cPOHC output rate measured with MM5 sampling train.

Bis(2-chloroisopropyl)ether was not detected in the VOST train.

TABLE 151. CHLORIDE CONCENTRATION IN MAKEUP WATER AND SCRUBBER DISCHARGE SAMPLES, PERCENT -- SITE G

Sample Type	Test 1	Test 2	Test 3	Average
Makeup water	0.003	0.0025	0.003	0.003
Recovery scrubber discharge ^a	2.06 ^b	2.00	2.14	2.07
HCl scrubber	0.31	0.31	0.26	0.29

^aThese samples were analyzed in duplicates because of questionable results during the first analysis, especially with regard to test 1 samples

^bThis result is based on analysis of two of the three composited samples. The third composited sample caused the Cl⁻ concentration to reach 5.58 percent, which was considered suspect due to erroneous Cl⁻ mass balance.

TABLE 152. CHLORIDE BALANCE -- SITE G

Test Number	Cl ⁻ Input	Cl ⁻ Output, kg/s (lb/hr)			Balance, Percent Out/In
	kg/s (lb/hr) ^a	Recovery Scrubber ^b	HCl Scrubber	Stack Gas	
1	0.106 (837)	0.108 (855)	0.031 (245)	4.38 x 10 ⁻⁴ (3.50)	131
2	0.110 (875)	0.105 (830)	0.032 (254)	4.18 x 10 ⁻⁴ (3.34)	124
3	0.103 (815)	0.112 (888)	0.026 (206)	4.77 x 10 ⁻⁴ (3.77)	134
Test program average	(842)	0.109 (855)	0.029 (230)	4.57 x 10 ⁻⁴ (3.60)	129

^aChloride input is based on the ultimate analysis of the fuel

^bOutput rate is based on concentration and the unmeasured water discharge rate of 5.2 l/s (83 gpm)

TABLE 153. SUMMARY OF PARTICULATE CATCHES AND EMISSIONS -- SITE G

Test Number	Particulate Catches (mg)			Total Emissions		
	Probe and Nozzle	Filter ^b	Total	g/dscm (10 ⁻⁶ lb/ft ³)	ng/j ^a (lb/10 ⁶ Btu)	10 ⁻³ kg/s (lb/hr)
1	642.6	1,782	2,424	0.402 (25.1)	179 (0.389)	0.877 (6.91)
2	554.6	73.4	628.0	0.089 (5.50)	38.2 (0.083)	1.79 (1.42)
3	798.8	17.0	815.8	0.106 (6.58)	43.5 (0.095)	0.214 (1.70)
Test program average	665.3	701.0	1,366.3	0.199 (12.4)	82.3 (0.180)	0.403 (3.18)

^aOn heat input basis^bWeight of ash on the filter

TABLE 154. THROX FEED ASH CONTRIBUTION TO
PARTICULATE EMISSIONS -- SITE G

Test Number	Ash Input ^a mg/s (lb/hr)	Particulate Emissions mg/s (lb/hr)
1	2.89 (0.023)	877 (6.91)
2	6.81 (0.054)	180 (1.42)
3	10.4 (0.083)	214 (1.70)
Test program average	6.70 (0.053)	403 (3.18)

^aBased on average ash concentration in the THROX
feed and flowrate for each test

TABLE 155. CHLORIDE STACK EMISSION -- SITE G

Test Number	Run	Total Chloride (mg)	Flue Gas Volume Sampled, m ³ (ft ³)	HCl Emission Rate, g/s (lb/hr)	
				Run Specific	Test Average
1	A	87.75	0.439 (15.5)	0.44 (3.54)	0.45 (3.60)
	B	100.68	0.487 (17.2)	0.46 (3.66)	
2	A	105.3	0.481 (17.0)	0.46 (3.62)	0.43 (3.43)
	B	91.51	0.468 (16.5)	0.41 (3.24)	
3	A	141.24	0.632 (22.3)	0.46 (3.70)	0.49 (3.88)
	B	130.11	0.525 (18.7)	0.51 (4.06)	
Test program average	--	109.43	0.505 (17.5)	0.47 (3.70)	0.47 (3.70)

TABLE 156. SUMMARY OF POHC'S STACK EMISSION RATES^a -- SITE G

THROX Feed Component	Test Number			Average
	1	2	3	
Bis(2-chloroisopropyl)ether	<0.2	<0.2 to 1.2 (0.4)	<0.2	<0.2
1-Chloro-2-propanol	<2	<2	<2	<2
t-1,3-Dichloropropylene	<2	<2	<2	<2
Epichlorohydrin	<2	<2	<2	<2
Carbon tetrachloride	53 to 150 (93)	120 to 800 (460)	72 to 180 (110)	190
Acetone/propionaldehyde	<2 to 220 (79)	<2	<2 to 1,600 (540)	230

^aMicrograms per second

Less than values indicate the detection limit of the analysis

TABLE 157. SUMMARY OF POHC DRE'S, PERCENT -- SITE G

POHC	Test 1	Test 2	Test 3	Weighted Average for All Three Tests
Bis(2-chloroisopropyl)ether	>99.9999	>99.9999	>99.9999	>99.9999
1-Chloro-2-propanol ^a	>99.9999	>99.9999	>99.9999	>99.9999
t-1,3-Dichloropropylene ^a	>99.9999	>99.9999	>99.9999	>99.9999
Epichlorohydrin	>99.9999	>99.9999	>99.9999	>99.9999
Carbon tetrachloride	99.9990	99.9951	99.9989	99.998
Propionaldehyde ^b	99.963	>99.998	99.750	99.887

^aBecause of the coelution of these two compounds during GC/FID of THROX feed, the DRE of each was calculated based on 67 percent of the combined THROX concentration attributed to 1-chloro-2-propanol and 33 percent to t-1,3-dichloropropylene

^bDRE's are based on emissions of acetone/propionaldehyde attributed entirely to propionaldehyde

TABLE 158. VOLATILE ORGANIC EMISSIONS, TEST 1 -- SITE G

Compound	Trap Sample Concentration (A+B) ^a , (ng)					Average Emission Rate ^b µg/s
	Sample			Blanks		
	Run 1	Run 2	Run 3	Field	Trip	
<u>RCRA Appendix VIII</u>						
Methylene chloride	6,800	7,000	6,200	5,000	2,000	180
1,1-Dichloroethylene	7	6	5	ND ^c	ND	0.66
Chloroform	20,000	71,000	74,000	42	75	6,000
1,2-Dichloroethane	160	130	140	ND	ND	15
1,1,1-Trichloroethane	220	74	170	7	160	ND
Carbon tetrachloride	1,400	770	510	11	14	93
1,2-Dichloropropane	80	33	89	24	120	ND
Trichloroethylene	160	50	73	29	160	ND
Benzene	110	200	87	22	140	ND
Tetrachloroethylene	180	95	150	74	200	ND
Toluene	260	110	150	90	130	4.6
Chlorobenzene	170,000	7,000	760	26	62	6,000
Chloromethane	200	230	1,800,000	16	120	66,000
Vinyl chloride	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND
t-1,2-Dichloroethylene	11	9	9	11	ND	ND
<u>Other</u>						
Chloroethane	12	ND	10	ND	ND	0.77
Ethylbenzene	70	30	33	4	46	ND
Acetone/propionaldehyde	170	2,100	ND	ND	87	71
Dichlorobromomethane	5,200	3,500	9,400	ND	ND	660

^aOrganic concentrations for each test run correspond to the sum of concentration found in the Tenax (A) and Tenax/charcoal (B) traps

^bEmissions are based on concentrations corrected for the higher blank concentration from either the field or trip blank samples

^cNot detected. Detection limit of 10 ng per trap or 20 ng per pair of traps.

TABLE 159. VOLATILE ORGANIC EMISSIONS, TEST 2 -- SITE G

Compound	Trap Sample Concentration (A+B) ^a , (ng)					Average Emission Rate ^b µg/s
	Sample			Blanks		
	Run 1	Run 2	Run 3 ^c	Field	Trip	
<u>RCRA Appendix VIII</u>						
Methylene chloride	10,000	3,000		4,000	2,000	250
1,1-Dichloroethylene	13	ND ^d		ND	ND	0.65
Chloroform	43,000	2,700		79	75	2,300
1,2-Dichloroethane	48,000	250		26	ND	2,400
1,1,1-Trichloroethane	120	110		310	160	ND
Carbon tetrachloride	8,100	1,200		13	14	460
1,2-Dichloropropane	1,700	120		91	120	80
Trichloroethylene	75	120		110	160	ND
Benzene	560	60		91	140	17
Tetrachloroethylene	14,000	1,100		220	200	750
Toluene	410	400		93	130	28
Chlorobenzene	1,900	1,300		170	62	148
Chloromethane	16,000	250		440	120	750
Vinyl chloride	23	ND		ND	ND	1.2
1,1-Dichloroethane	6	ND		ND	ND	0.3
Bromomethane	ND	16		ND	ND	0.8
<u>Other</u>						
Chloroethane	24	16		ND	ND	2.0
Ethylbenzene	73	47		28	46	1.4
Acetone/propionaldehyde	73	350		690	87	ND
Dichlorobromomethane	1,600	1,700		ND	ND	170

^aOrganic concentrations for each test run correspond to the sum of concentration found in the Tenax (A) and Tenax/charcoal (B) traps

^bEmissions are based on concentrations corrected for the higher blank concentration from either the field or trip blank samples

^cRun 3 data were lost due to poor recovery of internal standards while attempting to analyze with GC/Hall instrumentation

^dNot detected. Detection limit of 10 ng per trap or 20 ng per pair of traps.

TABLE 160. VOLATILE ORGANIC EMISSIONS, TEST 3 -- SITE G

Compound	Trap Sample Concentration (A+B) ^a , (ng)					Average Emission Rate ^b µg/s
	Sample			Blanks		
	Run 1	Run 2	Run 3	Field	Trip	
<u>RCRA Appendix VIII</u>						
Methylene chloride	5,500	1,200	3,200	4,500	2,000	ND ^c
1,1-Dichloroethylene	40	26	ND	ND	ND	2.1
Chloroform	3,200	2,700	2,900	32	75	280
1,2-Dichloroethane	390	1,900	1,000	15	ND	100
1,1,1-Trichloroethane	72	280	120	230	160	ND
Carbon tetrachloride	790	1,000	1,900	20	14	110
1,2-Dichloropropane	140	480	750	85	120	32
Trichloroethylene	63	37	79	120	160	ND
Benzene	230	64	92	86	140	ND
Tetrachloroethylene	770	2,000	6,300	200	200	270
Toluene	2,000	1,200	820	150	130	110
Chlorobenzene	240	150	180	15	62	12
Chloromethane	190	110	80	260	120	ND
Vinyl chloride	11	ND	ND	ND	ND	0.35
<u>Other</u>						
Chloroethane	ND	46	26	ND	ND	2.3
Ethylbenzene	310	130	78	30	46	12
Acetone/Propionaldehyde	100	140	18,000	210	87	550
Dichlorobromomethane	2,000	1,600	1,600	ND	ND	160

^aOrganic concentrations for each test run correspond to the sum of concentration found in the Tenax (A) and Tenax/charcoal (B) traps

^bEmissions are based on concentrations corrected for the higher blank concentration from either the field or trip blank

^cNot detected. Detection limit of 10 ng per trap or 20 ng per pair of traps.

TABLE 161. SEMIVOLATILE ORGANIC EMISSIONS, TEST 1 -- SITE G

Compound	Sample Concentration (μg)		Emission Rate ($\mu\text{g/s}$)
	MM5 Train	XAD-Blank	
<u>RCRA Appendix VIII</u>			
Bis(2-chloroisopropyl)ether	ND ^a	ND	ND
2,4-Dimethylphenol	5.3	ND	1.9
Naphthalene	11	4.9	2.2
2,4,6-Trichlorophenol	4.9	ND	1.8
Fluorene	2.3	ND	0.82
Dimethyl phthalate	21	ND	7.7
Hexachlorobenzene	16	ND	6.0
Butyl benzyl phthalate	7.7	1.7	2.1
Bis(2-ethylhexyl)phthalate	71	9.5	22
Dibutyl phthalate	16	ND	6.0
Phenol	ND	ND	ND
<u>Other</u>			
Phenanthrene	4.6	ND	1.6
Vinyl crotonaldehyde	80	ND	29
Cyclohexanone	100	ND	36
Benzaldehyde	10	ND	3.6
Chlorocyclohexanol	600	ND	210
Chlorocyclohexanone	120	ND	43
Dichlorocyclohexane	200	ND	71
Chlorocyclohexenone	ND	ND	ND
Chlorocyclohexene	ND	ND	ND

^aNot detected. Detection limit generally 1 $\mu\text{g}/\text{sample}$ for RCRA Appendix VIII compounds and 10 $\mu\text{g}/\text{sample}$ for the other compounds.

TABLE 162. SEMIVOLATILE ORGANIC EMISSION, TEST 2 -- SITE G

Compound	Sample Concentration (μg)		Emission Rate ($\mu\text{g/s}$)
	MM5 Train	XAD-Blank	
<u>RCRA Appendix VIII</u>			
Bis(2-chloroisopropyl)ether	3.7	ND ^a	1.2
2,4-Dimethylphenol	ND	ND	ND
Naphthalene	9.8	4.9	1.6
2,4,6-Trichlorophenol	24	ND	15
Fluorene	ND	ND	ND
Dimethyl phthalate	5.4	ND	1.8
Hexachlorobenzene	13	ND	4.2
Butyl benzyl phthalate	9.5	1.7	3.1
Bis(2-ethylhexyl)phthalate	109	9.5	32
Dibutyl phthalate	ND	ND	ND
Phenol	6.2	ND	2.0
<u>Other</u>			
Phenanthrene	ND	ND	ND
Vinyl crotonaldehyde	ND	ND	ND
Cyclohexanone	ND	ND	ND
Benzaldehyde	ND	ND	ND
Chlorocyclohexanol	320	ND	110
Chlorocyclohexanone	60	ND	20
Dichlorocyclohexane	200	ND	65
Chlorocyclohexenone	70	ND	23
Chlorocyclohexene	80	ND	26

^aNot detected. Detection limit generally 1 $\mu\text{g}/\text{sample}$ for RCRA Appendix VIII compounds and 10 $\mu\text{g}/\text{sample}$ for the other compounds.

TABLE 163. SEMIVOLATILE ORGANIC EMISSIONS, TEST 3 -- SITE G

Compound	Sample Concentration (μg)		Emission Rate ($\mu\text{g/s}$)
	MM5 Train	XAD-Blank	
<u>RCRA Appendix VIII</u>			
Bis(2-chloroisopropyl)ether	ND ^a	ND	ND
2,4-Dimethylphenol	ND	ND	ND
Naphthalene	10	4.9	1.5
2,4,6-Trichlorophenol	28	ND	8.0
Fluorene	ND	ND	ND
Dimethyl phthalate	14	ND	4.0
Hexachlorobenzene	21	ND	5.9
Butyl benzyl phthalate	4.3	1.7	0.76
Bis(2-ethylhexyl)phthalate	46	9.5	11
Dibutyl phthalate	6.3	ND	1.8
Phenol	ND	ND	ND
<u>Other</u>			
Phenanthrene	ND	ND	ND
Vinyl crotonaldehyde	ND	ND	ND
Cyclohexanone	ND	ND	ND
Benzaldehyde	ND	ND	ND
Chlorocyclohexanol	210	ND	59
Chlorocyclohexanone	10	ND	2.9
Dichlorocyclohexane	60	ND	17
Chlorocyclohexenone	ND	ND	ND
Chlorocyclohexene	ND	ND	ND

^aNot detected. Detection limit generally 1 $\mu\text{g}/\text{sample}$ for RCRA Appendix VIII compounds and 10 $\mu\text{g}/\text{sample}$ for the other compounds.

TABLE 164. MAJOR CHLORINATED PIC EMISSIONS -- SITE G

Compound	Test 1			Test 2			Test 3			Test Program Average		
	µg/s	µg/dscm	ppb	µg/s	µg/dscm	ppb	µg/s	µg/dscm	ppb	µg/s	µg/dscm	ppb
Chloroform (CHCl ₃)	2,100 to 8,200 (6,000) ^a	990 to 3,800 (2,800)	180 to 710 (520)	210 to 4,300 (2,300)	120 to 2,100 (1,100)	23 to 400 (210)	240 to 300 (280)	120 to 150 (140)	22 to 28 (26)	2,600	1,400	260
Methylene chloride (CH ₂ Cl ₂)	130 to 210 (180)	61 to 96 (81)	16 to 25 (21)	ND to 600 (250)	ND to 290 (120)	ND to 77 (32)	ND to 97 (ND)	ND	ND	130	67	18
Chloromethane (CH ₃ Cl)	8.2 to 190,000 (66,000)	3.8 to 89,000 (30,000)	1.8 to 42,000 (14,000)	ND to 1,600 (750)	ND to 760 (370)	ND to 370 (180)	ND	ND	ND	20,000	10,000	4,800
Chlorobenzene (C ₆ H ₅ Cl)	77 to 18,000 (6,000)	35 to 8,400 (2,800)	7.5 to 1,800 (600)	110 to 180 (140)	54 to 86 (69)	12 to 19 (15)	5 to 17 (12)	2.5 to 8.3 (6.0)	0.5 to 1.8 (1.3)	1,900	960	210
1,2-Dichloroethane (C ₂ H ₄ Cl ₂)	14 to 17 (15)	6.3 to 7.9 (7.1)	1.5 to 1.9 (1.7)	22 to 4,800 (2,400)	11 to 2,400 (1,200)	2.7 to 580 (290)	36 to 170 (100)	18 to 83 (50)	4.3 to 20 (12)	830	420	100
Tetrachloroethylene (C ₂ HCl ₄)	ND ^c	ND	ND	95 to 1,400 (750)	42 to 690 (370)	16 to 260 (140)	55 to 190 (270)	28 to 89 (130)	10 to 15 (51)	350	170	67
Dichlorobromomethane (CHBrCl ₂) ^b	370 to 990 (600)	170 to 460 (300)	25 to 67 (44)	160 to 170 (170)	79 to 83 (81)	11 to 12 (12)	140 to 190 (160)	71 to 93 (81)	11 to 14 (12)	310	150	22

^aNumber in parentheses indicates test run average also shown in tables 5-2 through 5-4.
^bNot a RCRA Appendix VIII compound.
^cNot detected. Detection limit generally less than 5 µg/s.

TABLE 165. SUMMARY OF CC14 DRE'S -- SITE G

Test Number	Run Number	POHC Feed Rate (10 ⁶ µg/s)	POHC Emission Rate (µg/s)	Test Run DRE (percent)	Test Average DRE (percent)
1	1	9.74	150	99.998	99.9990
	2	9.74	82	99.9992	
	3	9.74	53	99.9995	
2	1	9.36	800	99.992	99.9951
	2	9.36	120	99.998	
	3 ^a	9.71	--	--	
3	1	10.6	72	99.9993	99.9989
	2	10.7	93	99.9991	
	3	9.78	180	99.998	
Average for all tests		9.88	190	99.998	--

^aNo data are available for sorbent traps taken during this test run

TABLE 166. SUMMARY OF PROPIONALDEHYDE DRE'S -- SITE G

Test Number	Run Number	Feed Rate (10 ⁶ µg/s)	Emission Rate ^a (µg/s)	Test Run DRE (percent)	Test Average DRE (percent)
1	1	0.219	18	99.992	99.963
	2	0.211	220	99.896	
	3	0.211	<2	>99.998	
2	1	0.161	<2	>99.998	>99.998
	2	0.188	<2	>99.998	
	3 ^b	0.188	--	--	
3	1	0.217	<2	>99.999	99.750
	2	0.217	<2	>99.999	
	3	0.206	1,600	99.223	
Average for all tests		0.204	230	99.887	--

^aAssumes that 100 percent of the acetone/propionaldehyde concentration attributable to propionaldehyde only

^bNo data available for sorbent traps taken during this test run

TABLE 167. TEST 1 -- ANALYSIS RESULTS OF MAKEUP WATER AND SCRUBBER DISCHARGE SAMPLES, ng/ml -- SITE G

Compound	Makeup Water	Recovery Scrubber Discharge	HCl Scrubber Discharge
Methylene chloride	28	1	57
Chloroform	38	ND ^a	26
1,2-Dichloroethane	ND	3	ND
Carbon tetrachloride	ND	ND	3
Bromodichloromethane	33	2	100
Trans-1,3-dichloropropylene	5	ND	7
Trichloroethylene	ND	1	4
Chlorodibromomethane ^b	92	28	370
Bromoform	190	10	280
Chlorobenzene	ND	2	5
Epichlorohydrin	<10	<10	<10
1-Chloro-2-propanol	<10	<10	<10

^aNot detected. Detection limit = 1.0 ng/ml.

^bCoelutes with 1,1,2-trichloroethane and cis-1,3-dichloropropene

TABLE 168. TEST 2 -- ANALYSIS RESULTS OF MAKEUP WATER AND SCRUBBER DISCHARGE SAMPLES, ng/ml -- SITE G

Compound	Makeup Water	Recovery Scrubber Discharge	HCl Scrubber Discharge
Methylene chloride	32	1,300	32
Chloroform	48	1	28
1,2-Dichloroethane	ND ^a	ND	ND
Carbon tetrachloride	ND	ND	ND
Bromodichloromethane	19	3	92
Trans-1,3-dichloropropylene	1	ND	ND
Trichloroethylene	ND	ND	ND
Chlorodibromomethane ^b	9	32	240
Bromoform	7	100	440
Chlorobenzene	ND	ND	ND
Epichlorohydrin	<10	<10	<10
1-Chloro-2-propanol	<10	<10	<10

^aNot detected. Detection limit = 1.0 ng/ml.

^bCoelutes with 1,1,2-trichloroethane and cis-1,3-dichloropropene

TABLE 169. TEST 3 -- ANALYSIS RESULTS OF MAKEUP WATER AND SCRUBBER DISCHARGE SAMPLES, ng/ml -- SITE G

Compound	Makeup Water	Recovery Scrubber Discharge	HCl Scrubber Discharge
Methylene chloride	110	92	39
Chloroform	63	ND ^a	22
1,2-Dichloroethane	ND	ND	ND
Carbon tetrachloride	ND	ND	ND
Bromodichloromethane	23	ND	85
Trans-1,3-dichloropropylene	3	ND	ND
Trichloroethylene	ND	ND	ND
Chlorodibromomethane ^b	7	ND	320
Bromoform	ND	ND	280
Chlorobenzene	ND	ND	ND
Epichlorohydrin	<10	<10	<10
1-Chloro-2-propanol	<10	<10	<10

^aNot detected. Detection limit = 1.0 ng/ml.

^bCoelutes with 1,1,2-trichloroethane and cis-1,3-dichloropropene

TABLE 171. THROX FEED ANALYSIS RESULTS^a, mg/ml -- SITE G

Compound	Test 1			Test 2		Test 3		Test Program Average
	Sample A	Sample B	Sample C	Sample A	Sample B	Sample A	Sample B	
Bis(2-chloroisopropyl)ether	539 to 542 (541)	394 to 403 (399)	513 to 574 (544)	504 to 509 (507)	503 to 500 (502)	489 to 513 (501)	513 to 519 (516)	501
1-chloro-2-propanol ^b and 1,1,3-dichloropropylene	377 to 418 (399)	377 to 385 (381)	477 to 491 (484)	462 to 478 (470)	417 to 384 (406)	547 to 481 (514)	430 to 523 (477)	447
Epichlorohydrin	160 to 178 (169)	162 to 160 (161)	199 to 204 (202)	193 to 195 (194)	176 to 185 (181)	229 to 199 (214)	183 to 217 (200)	189
Carbon tetrachloride	44 to 45 (45)	(45)	(41)	(43)	(47)	(50)	(44)	45
Propionaldehyde	1.13 to 0.99 (1.06)	(0.98)	(0.91)	(0.75)	(1.01)	(1.02)	(0.91)	0.95
Cis-1,3-dichloropropylene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

^aAnalyses performed by GC/FID technique. Ranges indicate results of duplicate analyses per sample. Number in parentheses corresponds to the arithmetic average of duplicate analysis results.

^bCoeluting chromatographic peak

5.8 SITE H

TABLE 172. ULTIMATE FUEL ANALYSIS -- SITE H

Composition, percent by weight	Coal	Waste fuel		
	Test 1 to Test 4	Test 2	Test 3	Test 4
Carbon	77.4	34.0	33.6	36.8
Hydrogen	4.9	6.5	6.2	7.1
Nitrogen	1.85	0.4	0.4	0.3
Sulfur	0.725	0.01	0.01	<0.01
Chlorine	0.10	5.67	9.65	9.75
Oxygen	5.4	45.8	54.5	46.4
Ash	9.74	0.0009	0.0018	0.0007
Moisture	1.27	13.3	5.30	9.35
Higher heating kJ/kg value, (Btu/lb)	32,250 (13,875)	15,400 (6,630)	15,300 (6,565)	16,700 (7,171)

^aAverage of samples taken during each test.

TABLE 173. COAL ULTIMATE ANALYSIS -- SITE H

Composition, percent by weight	Test 1	Test 2	Test 3	Test 4
C	74.9	77.7	78.1	78.9
H	4.6	4.9	5.0	5.1
N	2.2	2.5	1.5	1.2
S	0.77	0.75	0.65	0.73
C	0.1	0.1	0.1	0.1
O (by difference)	7.0	4.7	5.2	4.7
Ash	10.5	9.50	9.59	9.38
Moisture	1.67	1.24	1.03	1.14
Higher heating value, kJ/kg (Btu/lb)	31,600 (13,600)	32,300 (13,900)	32,300 (13,900)	32,800 (14,100)

TABLE 174. RESULTS OF GC/MS ANALYSES FOR THE COMPOSITE SAMPLES -- SITE H

Compound	Concentration (mg/ml)		
	Test 1	Test 2	Test 3
1,1,1-Trichloroethane	40.6; 38.4	19.6; 21.0	38.0; 34.0
Carbon Tetrachloride	48.0; 51.0	24.4; 29.4	46.0; 42.2
Chlorobenzene	44.4; 52.8	26.2; 26.2	32.0; 28.6

5.9 SITE I

TABLE 175. NO_x EMISSION RESULTS: EFFECTS OF WASTE FUEL FIRING AND STAGED COMBUSTION ON NO_x EMISSIONS -- SITE I

Test Set/ Run Nos./ Description	Mean NO _x Emissions (lb mole/hr)*	Fuel Derived N as NO ₂ (lb mole/hr)*	Estimated Background NO _x Emissions Contribution (lb mole/hr)*	Estimated Waste Fuel NO _x Emissions Contribution (lb mole/hr)*	Waste Fuel NO _x as Percent of Waste Fuel NO ₂ - Equivalent (%)
1 1,2,3 background, unstaged	9.637 x 10 ⁻² (6.559 x 10 ⁻² , 1.271 x 10 ⁻¹)	-	9.637 x 10 ⁻²	-	-
2 4,5,6 waste, staged	6.279 x 10 ⁻¹ (3.718 x 10 ⁻¹ , 8.840 x 10 ⁻¹)	2.342	1.124 x 10 ⁻¹	5.155 x 10 ⁻¹	22.0
3 7,8,12 background, staged	1.234 x 10 ⁻¹ (8.157 x 10 ⁻² , 1.652 x 10 ⁻¹)	-	1.1234 x 10 ⁻¹	-	-
4 9,10,11 waste, unstaged	1.755 (1.623, 1.887)	2.319	18.585 x 10 ⁻²	1.669	72.0

*All NO_x emissions values expressed as NO₂ - equivalent. Ninety-five percent confidence limits for the true mean NO_x emissions are shown in parenthesis.

TABLE 176. MATERIAL BALANCE CLOSURE FOR CHLORIDE AND CARBON -- SITE I

Test	Chlorine	Carbon
1	-	117
2	-	113
3	-	112
4	122	112
5	150	124
6	111	100
7	-	114
8	-	114
12	-	120
9	131	122
10	130	116
11	116	115
Average, background tests (Test 1-3, 7, 8, 12)	-	115
Average, hazardous waste tests (Test 4-6, 9-11)	127	115

TABLE 177. RESULTS OF IC CHROMATOGRAPHIC ANALYSIS FOR CHLORIDE ION --
SITE 1

Sample Number	Sample Type	Cl ⁻ Concentration (ug/ml)	Total Sample Volume (ml)	Total Cl ⁻ (mg)	Volume Sample (dscm)	Stack GAS Concentration (mg/m ³)
D2B-HCl-ST-BL	Blank	4.61	388	1.79	-	-
D2B-HCl-ST-BL	Blank	4.99	260	1.30	-	-
D2B-Blank-HCl	Blank	5.30	400	2.12	-	-
Test 1	HCl	5.70	1400	7.98	3.120	2.56
Test 2	HCl	4.54	710	3.22	2.659	1.21
Test 3	HCl	5.30	675	3.58	2.307	1.55
Test 4	HCl	1270	820	1041	1.870	556.7
Test 5	HCl	1400	855	1197	1.868	640.8
Test 6	HCl	1040	800	832	1.344	619.0
Test 7	HCl	10.4	950	9.90	2.196	4.51
Test 8	HCl	9.47	875	8.29	2.017	4.11
Test 9	HCl	1300	925	1203	2.010	598.5
Test 10	HCl	1240	900	1116	1.870	596.8
Test 11	HCl	1300	815	1060	1.920	552.1
Test 12	HCl	17.8	800	14.24	2.031	7.01

TABLE 178. DESTRUCTION EFFICIENCIES FOR THE SIX HAZARDOUS WASTE TESTS --
SITE I

Run Number	Benzene	Chloro- benzene	Nitro- benzene	Toluene	Aniline	Trichloro- ethylene	Carbon- tetrachloride
4	99.997	99.998	99.999	99.997	99.998	99.999	99.997
Test 2 5	99.968	99.998	99.999	99.997	99.998	99.998	99.997
6	99.946	99.998	99.999	99.996	99.998	99.999	99.996
4,5,6 (avg)	99.970	99.998	99.999	99.997	99.998	99.999	99.997
9	99.978	99.998	99.999	99.998	99.997	99.999	99.996
Test 4 10	99.969	99.998	99.999	99.997	99.998	99.999	99.995
11	99.983	99.998	99.999	99.998	99.997	99.999	99.999
9,10,11 (avg)	99.977	99.998	99.999	99.998	99.998	99.999	99.997

TABLE 179. EMISSION DATA -- SITE I

Test	Method	$\mu\text{g}/\text{m}^3$						
		Benzene	Chloro- benzene	Nitro- benzene	Toluene	Aniline	Trichloro- ethylene	Carbon- tetrachloride
1	VOST Modified Method 5	1.04 0.3	0.3 3.3	6.5	5.7 0.3	3.3	0.5	1
2	VOST Modified Method 5	34 0.4	0.3 4.7	9.4	3.8 0.4	4.7	0.5	1
3	VOST Modified Method 5	31.9 0.4	2.60 5.1	10.2	5.1 0.4	5.1	0.8	1.4
4	VOST Modified Method 5	31.5 0.4	2.2 5.0	46.4	3.05 0.4	5.0	0.6	4.4
5	VOST Modified Method 5	44.5 0.4	23.5 4.5	44.8	7.7 0.4	4.5	1.9	3.5
6	VOST Modified Method 5	115 0.4	4.1 5.3	10.7	13.4 0.4	5.3	0.7	6.8
7	VOST Modified Method 5	69.5 0.4	9.6 5.4	10.7	9.0 0.4	5.4	0.6	1.6
8	VOST Modified Method 5	31.5 0.4	3.9 4.9	9.8	15.8 0.4	4.9	0.6	1.6
9	VOST Modified Method 5	40.5 0.4	4.2 4.4	23.6	4.1 0.4	4.4	0.7	7.7
10	VOST Modified Method 5	49.1 0.4	3.4 4.4	8.8	8.8 0.4	4.4	0.6	6.6
11	VOST Modified Method 5	35.2 0.4	0.3 4.7	9.4	3.2 0.4	4.7	0.6	6.0
12	VOST Modified Method 5	36.6 0.3	1.4 4.0	8.0	6.0 0.3	4.0	0.6	1.4

TABLE 180. WASTE FEED DATA -- SITE I

Run No.	Feed Rate, GPM	Fuel Specific Gravity C 60°F	Waste Analysis (wt. %) ¹							
			4	5	6	9	10	11		
4	0.600	1.1979	Benzene	1.8	1.4	1.8	1.9	1.5	2.1	
5	0.600	1.1969	Toluene	3.8	2.7	3.7	3.7	2.8	3.9	
6	0.600	1.1972	CCl ₄	1.8	1.5	1.8	1.9	1.5	2.1	
9	0.590	1.1971	Chlorobenzene	3.4	2.8	3.3	3.3	2.8	3.5	
10	0.598	1.1971	1,1,2 TCE	1.8	1.4	1.8	1.9	1.4	2.0	
11	0.600	1.1973	Aniline	2.7	2.8	2.4	1.8	2.8	1.8	
	Avg. = 0.598	Avg. = 1.1973	Nitrobenzene	82.0	84.3	82.5	83.4	85.5	82.9	

¹From GC/MS analysis. Corrected for water measured in samples. Thus, balance assumed to be water.

5.10 SITE J

TABLE 181. CHLORINE BALANCE -- SITE J

Date	MH5 Run Number	Condi- tion	Waste Feed (mg/sec)				Total Feed HCl (mg/sec)	Outlet HCl (mg/sec)	Chlorine Recovery Inlet x 100
			CCl ₄	as HCl	TCE	as HCl			
7/27	1	1	346.5	328.6	292.3	243.4	606	316	52
7/28	2	1	327.6	310.6	340.2	283.3	634	401	53
7/28	3	1	250.7	237.7	260.8	217.2	485	443	91
7/29	4	2	551.9	523.3	535.5	445.9	1032	770	75
8/2	8	2	420.0	398.3	502.9	418.7	881	500	63
8/2	9	2	466.4	442.3	558.5	465.0	979	806	82
8/1	5	3	249.1	236.2	261.5	217.7	489	578	118
8/1	6	3	248.6	235.7	261.0	217.3	488	582	119
8/2	7	3	252.2	239.2	264.7	220.4	495	226	46
8/3	10	4	385.3	365.4	409.7	341.1	763	404	53
8/3	11	4	418.2	396.6	444.6	370.2	829	514	62
8/3	12	4	367.4	348.4	390.7	325.3	728	626	86
8/4	13	5	142.0	134.7	428.3	356.6	517	218	42
8/4	14	5	141.7	134.4	427.4	356.1	515	351	68
8/4	15	5	192.4	182.4	483.3	402.4	614	133	22
8/5	16	6	545.3	517.1	959.0	798.5	1382	873	63
8/5	17	6	602.1	570.9	1057.0	880.1	1525	898	59
Average:									68.8
Standard Deviation (s):									28.2

TABLE 182. COMPARISON OF ESTIMATES OF CHLORINE FLOWRATE -- SITE J

Test	Chlorine Flow Rates, mg/sec		
	Out	In	
		By Analysis	By Calculation
1	316	606	461
2	401	634	515
3	443	485	398
4	770	1032	837
5	500	881	865
6	806	979	959
7	578	489	470
8	582	488	479
9	226	495	476
10	404	763	742
11	517	829	806
12	626	728	708
13	218	517	532
14	351	515	532
15	133	614	533
16	873	1382	1309
17	898	1525	1446

TABLE 183. DESTRUCTION AND REMOVAL EFFICIENCIES (DRE'S) BY GC/FID-ECD --
SITE J

Test condition (no.)	Date	Fuel Blend No.	Conditions	Toluene (ppm)	Carbon tetrachloride (ppm)	Trichloro- ethylene (ppm)	Chlorobenzene (ppm)
1	7/27	1	Half load	GT*99.9956	GT 99.9982	GT 99.9932	GT 95.4680
	7/28	1	Half load	GT 99.9956	GT 99.9982	99.7452	GT 95.5195
	7/28	1	Half load	GT 99.9956	GT 99.9982	99.7930	GT 95.5268
2	7/29	1	Full load	GT 99.9961	GT 99.9984	GT 99.9939	GT 96.0372
	8/2	1	Full load	GT 99.9961	GT 99.9984	GT 99.9939	GT 96.0165
	8/2	1	Full load	GT 99.9961	GT 99.9984	GT 99.9939	GT 96.0158
3	8/1	2	Half load	GT 99.9957	GT 99.9981	GT 99.9965	GT 95.5305
	8/1	2	Half load	99.9837	†	GT 99.9965	GT 95.5473
	8/2	2	Half load	GT 99.9957	GT 99.9981	99.8359	GT 95.5544
4	8/3	1	Full load (high EA)	GT 99.9955	GT 99.9981	GT 99.9927	GT 95.2122
	8/3	1	Full load	GT 99.9955	GT 99.9981	GT 99.9927	GT 95.2003
	8/3	1	Full load (high EA)	GT 99.9955	GT 99.9981	†	GT 95.2123
5	8/4	1	Half load (high EA)	GT 99.9951	GT 99.9979	GT 99.9920	GT 95.2239
	8/4	1	Half load	GT 99.9951	GT 99.9979	†	GT 95.2258
	8/4	1	Half load (high EA)	GT 99.9951	GT 99.9979	GT 99.9920	GT 95.2258
6	8/5	2	Full load	GT 99.9963	GT 99.9984	GT 99.9969	GT 96.3424
	8/5	2	Full load	GT 99.9963	GT 99.9984	†	GT 96.3451
	8/5	2	Full load	GT 99.9963	GT 99.9984	GT 99.9969	GT 96.3468

* DREs so marked indicate instances wherein no POMIC was detected in the flue gas sample.

† No DRE computed because of instrument contamination from previously run standard.

TABLE 184. SUMMARY OF VOST BLANK ANALYSES -- SITE J

Condition Number	Blank I.D.	CCl ₄	TCE	O-d ₆	DCE-d ₄
	Trip	5	8	1868	2331
1	V-1	46	ND	336	568
	V-2	37	5	ND ^c	ND ^c
	V-3	11	10	1597	1961
2	V-4	83	3	660	828
	V-8	3	ND	559	821
	V-9	134	15	510	726
4	V-10	355	5	613	ND
	V-11	20	7	611	896
	V-12	58	36	508	764
5 ^a	V-13	---	---	---	---
	V-14	---	---	---	---
	V-15	23	29	791	1974
3	V-5	b	---	---	---
	V-6	1	3	493	709
	V-7	NQ	2	448	643
6 ^a	V-16	5	10	490	693
	V-16	---	---	---	---
	V-17	---	---	---	---

^a Only one pair of blanks exposed for this condition.

^b Samples lost by laboratory.

^c Surrogates omitted.

ND None Detected.

NQ Not Quantified.

TABLE 185. VOST AVERAGE BLANKS -- SITE J

Condition Number	Trip Blank Plus Run Blanks	Carbon Tetrachloride			Trichloroethylene		
		Avg. (ng)	s	3s	Avg. (ng)	s	3s
1	V-1, V-2, V-3	24.75	19.84	59.5	5.75	4.35	13.0
2	V-7, V-8, V-9	56.25	63.8	191.5	6.50	6.6	19.7
3	V-6, V-7	3.0	2.8	8.5	4.3	3.2	9.6
4	V-10, V-11, V-12	109.5	165.2	495.5	14.0	14.72	44.2
5	V-15	14.0	12.7	38.2	18.5	14.9	44.6
6	V-16	5.0	0	0	9.0	1.4	4.24

TABLE 186. VOST RESULTS -- SITE J

Condition Number	Run Number	Emission Rate ($\mu\text{g}/\text{sec}$)	
		CCl_4	TCE
1	V-1	>3.2	>0.2
	V-2	>11.8	>0.3
	V-3	<u>4.8</u>	<u>0.7</u>
	Average	>6.6	>0.33
2	V-4	>6.9	>0.5
	V-8	3.2	1.4
	V-9	<u>5.8</u>	<u>0.6</u>
	Average	>5.3	>0.8
3	V-5	>4.4	>2.5
	V-6	0.4	5.3
	V-7	<u>2.1</u>	<u>1.4</u>
	Average	>2.3	>3.1
4	V-10	>1.3	>0.8
	V-11	0.3	0.3
	V-12	<u>---</u>	<u>---</u>
	Average	0.8	>0.5
5	V-13	0.7	0.8
	V-14	2.3	0.8
	V-15	<u>0.6</u>	<u>12.2</u>
	Average	1.2	4.6
6	V-16	7.0	0.8
	V-16-1	4.0	0.6
	V-17	<u>3.3</u>	<u>0.7</u>
	Average	4.8	3.7

TABLE 187. MODIFIED METHOD 5 RESULTS -- SITE J

Run Number	Date	Condi- tion	Toluene Emission ^a		Chlorobenzene Emission ^a	
			(ug)	(ug/sec)	(ug)	(ug/sec)
1	7/27	1	ND	<20	ND	<41
2	7/28	1	410	212	140	72
3	7/28	1	<u>110</u>	<u>59</u>	<u>ND</u>	<u><43</u>
Avg.			<187	<97	<100	<52
4	7/29	2	1750	1555	330	293
8	8/02	2	180	83	ND	<37
9	8/02	2	<u>130</u>	<u>60</u>	<u>ND</u>	<u><37</u>
Avg.			687	477	<163	<110
5	8/01	3	1630	507	ND	<25
6	8/01	3	710	221	ND	<25
7	8/02	3	<u>180</u>	<u>52</u>	<u>ND</u>	<u><23</u>
Avg.			840	260	<80	<24
10	8/03	4	320	157	330	162
11	8/03	4	620	307	160	79
12	8/03	4	<u>780</u>	<u>367</u>	<u>ND</u>	<u><38</u>
Avg.			573	277	<190	<93
13	8/04	5	1270	378	ND	<24
14	8/04	5	320	96	ND	<24
15	8/04	5	<u>480</u>	<u>136</u>	<u>ND</u>	<u><23</u>
Avg.			690	203	<80	<23
16	8/05	6	3973	873	80	18
17	8/05	6	<u>630</u>	<u>197</u>	<u>320</u>	<u>100</u>
Avg.			2301	535	200	59
Blanks						
Filter			130		ND	
XAD			140		ND	
XAD			100		ND	
System			190		140	

^a Results are not blank corrected.

ND None detected.

TABLE 188. TRICHLOROETHYLENE DRE -- SITE J

Condition Number	Boiler Load	Excess Air (%)	Input Rate (mg/sec)	Emission Rate (μ g/sec)	DRE (%)
1	Half	38	298	0.33	99.9989
2	Full	38	532	0.8	99.9998
3	Half	31	262	3.1	99.9988
4	Full	41	415	0.5	99.9999
5	Half	50	446	4.6	99.9990
6	Full	17	1011	3.7	99.9996

CARBON TETRACHLORIDE DRE

Condition Number	Boiler Load	Excess Air (%)	Input Rate (mg/sec)	Emission Rate (μ g/sec)	DRE (%)
1	Half	38	308	6.6	99.9979
2	Full	38	479	5.3	99.9989
3	Half	31	250	2.3	99.9990
4	Full	41	390	0.8	99.9998
5	Half	50	159	1.2	99.9992
6	Full	17	574	4.8	99.9992

TABLE 189. CHLOROBENZENE DRE -- SITE J

Condition Number	Boiler Load	Excess Air (%)	Input Rate (mg/sec)	Emission Rate (μ g/sec)	DRE (%)
1	Half	38	108	52	99.9519
2	Full	38	204	110	99.9461
3	Half	31	109	24	99.978
4	Full	41	58	93	99.8397
5	Half	50	82	23	99.9720
6	Full	17	217	59	99.9728

TOLUENE DRE

Condition Number	Boiler Load	Excess Air (%)	Input Rate (mg/sec)	Emission Rate (μ g/sec)	DRE (%)
1	Half	38	28,700	97	99.9997
2	Full	38	56,100	477	99.9991
3	Half	31	31,000	260	99.9992
4	Full	41	49,400	277	99.9994
5	Half	50	22,800	203	99.9991
6	Full	17	58,200	535	99.9991

TABLE 190. COMPARISON OF VOST AND BAG METHOD RESULTS -- SITE J

Condition Number	VOST Run Number	Concentration of Target Compounds (ppm)			
		Carbon Tetrachloride		Trichloroethylene	
		VOST	Bag ^a	VOST	Bag ^b
1	V-1	0.011	ND	0.0001	<0.009
	V-2	0.004	ND	0.0001	0.34
	V-3	0.0014	ND	0.0002	1.61
2	V-4	0.0013	ND	0.0001	<0.009
	V-8	0.0006	<0.001	0.0003	<0.009
	V-9	0.0011	ND	0.0001	<0.009
3	V-5	0.0008	<0.001	0.0009	<0.009
	V-6	0.0001	b	0.002	<0.009
	V-7	0.0006	<0.001	0.0008	0.42
4	V-10	0.0003	<0.001	0.0002	<0.009
	V-11	0.0001	<0.001	0.0001	<0.009
	V-12	c	<0.001	c	d
5	V-13	0.0003	<0.001	0.0004	<0.009
	V-14	0.0008	<0.001	0.0003	d
	V-15	0.0002	<0.001	0.005	<0.009
6	V-16	0.0014	ND	0.002	<0.009
	V-16-1	0.0008	<0.001	0.0001	d
	V-17	0.00067	<0.001	<0.0001	<0.009

a Limit of detection 0.001 ppm.

b Limit of detection 0.009 ppm.

c No VOST data.

d No bag data.

ND None Detected.

TABLE 191. COMPARISON OF MM5 AND BAG METHOD RESULTS -- SITE J

Condition Number	MM5 Run Number	Concentration of Target Compound (ppm)			
		Toluene ^a		Chlorobenzene ^b	
		MM5	Bag	MM5	Bag
1	1	ND	<0.76	ND	<3.4
	2	0.105	<0.76	0.029	<3.4
	3	0.029	<0.76	ND	<3.4
2	4	0.498	<0.76	0.077	<3.4
	8	0.026	<0.76	ND	<3.4
	9	0.020	<0.76	ND	<3.4
3	5	0.240	<0.76	ND	<3.4
	6	0.103	2.88	ND	<3.4
	7	0.026	<0.76	ND	<3.4
4	10	0.049	<0.76	0.041	<3.4
	11	0.096	<0.76	0.020	<3.4
	12	0.120	<0.76	ND	<3.4
5	13	0.224	<0.76	ND	<3.4
	14	0.056	<0.76	ND	<3.4
	15	0.079	<0.76	ND	<3.4
6	16	0.295	<0.76	0.005	<3.4
	17	0.066	<0.76	0.028	<3.4

^a Detection limit 0.76 ppm.

^b Detection limit 3.4 ppm.

ND None Detected.

TABLE 192. FUEL ULTIMATE ANALYSIS* -- SITE J

Test condition (no.)	Date	Conditions	Ultimate analysis		
			Carbon lb/lb fuel	Hydrogen lb/lb fuel	Chlorine lb/lb fuel
<u>Blend No. 1</u>					
1	7/27	Half load	89.89	8.59	1.52
	7/28		89.89	8.59	1.52
	7/28		89.89	8.59	1.52
2	7/29	Full load	89.89	8.59	1.52
	8/2		89.91	8.60	1.49
	8/2		89.91	8.60	1.49
4	8/3	Full load (high EA)	89.96	8.60	1.44
	8/3		89.96	8.60	1.44
	8/3		89.96	8.60	1.44
5	8/4	Half load (high EA)	89.95	8.60	1.45
	8/4		89.95	8.60	1.45
	8/4		89.95	8.60	1.45
<u>Blend No. 2</u>					
3	8/1	Half load	89.25	8.53	2.22
	8/1		89.25	8.53	2.22
	8/2		89.25	8.53	2.22
6	8/5	Full load	89.24	8.52	2.24
	8/5		89.24	8.52	2.24
	8/5		89.24	8.52	2.24

* Calculated from fuel blend composition data and POHCs chemical composition.

TABLE 193. POHC'S COMPOSITION OF TEST FUEL, -- SITE J

Test Condition (no.)	Date	Conditions	Toluene (wt %)	Carbon tetrachloride (wt %)	Trichloro- ethylene (wt %)	Chlorobenzene (wt %)
Blend No. 1						
1	7/27	Half load	97.88	.53	1.07	.52
	7/28		97.88	.53	1.07	.52
	7/28		97.88	.53	1.07	.52
2	7/29	Full load	97.86	.53	1.07	.52
	8/2		97.91	.52	1.05	.52
	8/2		97.91	.52	1.05	.52
4	8/3	Full load	97.99	.50	1.01	.50
	8/3	(high EA)	97.99	.50	1.01	.50
	8/3		97.99	.50	1.01	.50
5	8/4	Half load	97.94	.50	1.01	.55
	8/4	(high EA)	97.94	.50	1.01	.55
	8/4		97.94	.50	1.01	.55
Blend No. 2						
3	8/1	Half load	97.01	.48	2.00	.51
	8/1		97.01	.48	2.00	.51
	8/2		97.01	.48	2.00	.51
6	8/5	Full load	96.97	.50	1.99	.54
	8/5		96.97	.50	1.99	.54
	8/5		96.97	.50	1.99	.54

TABLE 194. CONCENTRATIONS OF TARGET COMPOUNDS IN FUEL CONCENTRATION
(g/l) -- SITE J

Condition Number	Date	Carbon Tetrachloride		Trichloro- ethylene		Chlorobenzene		Toluene	
		By GC/FID	By Calc.	By GC/FID	By Calc.	By GC/FID	By Calc.	By GC/FID	By Calc.
1	7/27	10.4	4.5	8.7	9.2	3.1	4.5	833.8	837.9
	7/28	8.8	4.5	9.1	9.2	3.3	4.5	834.8	837.9
2	7/29	9.1	4.6	8.8	9.2	3.2	4.5	837.6	840.5
	8/2	7.3	4.5	7.2	9.0	3.0	4.5	844.3	843.8
3	8/1	5.4	4.1	16.2	17.0	2.9	4.3	824.6	823.7
	8/2	7.3	4.1	18.3	17.0	3.4	4.3	820.1	823.7
4	8/3	6.9	4.3	7.3	8.7	3.0	4.3	842.3	842.2
5	8/4	6.8	4.3	7.3	8.7	3.15	4.8	848.1	847.5
6	8/5	8.5	4.3	14.9	17.2	3.2	4.7	840.0	840.3
$\Sigma \frac{\text{Calc}}{\text{GC/FID}}$		0.57 $\pm$ 0.10		1.10 $\pm$ 0.10		1.43 $\pm$ 0.08		1.00 $\pm$ 0.002	

5.11 SITE K

TABLE 195. NITROGEN OXIDES AND SULFUR OXIDES EMISSIONS DURING THE TEST RUNS -- SITE K

Run Number	Composite Fuel Nitrogen Content ^a (wt % N)	NO _x Emissions Corrected to 3% O ₂ (ppmv, dry @ 3% O ₂)	Composite Fuel Sulfur Content ^a (wt % S)	SO ₂ Emissions Corrected to 3% O ₂ (ppmv, dry @ 3% O ₂)
<u>Test Set Number 1^b</u>				
Run No. 1	0.42	250	0.56	318
Run No. 2	0.45	293	0.79	298
Run No. 3	0.44	292	0.78	295
Average, Test Set No. 1	0.44	278	0.71	304
<u>Test Set Number 2^c</u>				
Run No. 5	0.22	150	0.26	133
Run No. 6	0.23	157	0.25	135
Run No. 7	0.21	158	0.25	139
Average, Test Set No. 2	0.22	155	0.25	136

^aComposite fuel nitrogen and sulfur contents based on the ultimate analyses in Table 2-5 and the heavy and light oil mass flow rates in Table 2-3.

^bTest set number one = background tests with No. 6 oil fired in the heavy oil train.

^cTest set number two = hazardous waste tests with 70% No. 6 oil/30% waste solvent fired in the heavy oil train and spiked waste solvent fired in the light oil train.

TABLE 196. EFFECT OF FUEL NITROGEN CONCENT ON NO_x EMISSIONS -- SITE K

Run Number	Fuel-Bound Nitrogen as NO ₂ -Equivalent			NO _x Emissions as NO ₂ (1b mole/hr)	NO _x Emissions as % of Input NO ₂ -Equivalent
	Heavy Oil (1b mole/hr)	Light Oil (1b mole/hr)	Total Input (1b mole/hr)		
<u>Test Set Number 1</u>					
Run No. 1	0.9321	-	0.9321	0.5209	55.88
Run No. 2	1.0045	-	1.0045	0.6097	60.70
Run No. 3	1.0397	-	1.0397	0.6022	57.92
Average, Test Set No. 1	0.9921	-	0.9921	0.5776	58.17
<u>Test Set Number 2</u>					
Run No. 5	0.2745	0.2434	0.5179	0.3134	60.51
Run No. 6	0.3435	0.1910	0.5345	0.3229	60.41
Run No. 7	0.3146	0.2030	0.5176	0.3413	65.94
Average, Test Set No. 2	0.3109	0.2125	0.5233	0.3259	62.29

TABLE 197. EFFECT OF FUEL SULFUR CONTENT ON SO₂ EMISSIONS -- SITE K

Run Number	Fuel-Bound Sulfur as SO ₂ -Equivalent			SO ₂ Emissions (lb mole/hr)	SO ₂ Emissions as % of Input SO ₂ -Equivalent
	Heavy Oil (lb mole/hr)	Light Oil (lb mole/hr)	Total Input (lb mole/hr)		
Test Set Number 1					
Run No. 1	0.5436	-	0.5436	0.6632	122.0
Run No. 2	0.7712	-	0.7712	0.6206	80.47
Run No. 3	0.8061	-	0.8061	0.6087	75.51
Average, Test Set No. 1	0.7070	-	0.7070	0.6308	89.22
Test Set Number 2					
Run No. 5	0.2401	0.0266	0.2667	0.2783	104.3
Run No. 6	0.2304	0.0209	0.2513	0.2783	110.7
Run No. 7	0.2170	0.0555	0.2725	0.3006	110.3
Average, Test Set No. 2	0.2292	0.0343	0.2635	0.2857	108.4

TABLE 198. CHLORIDE EMISSIONS DURING THE TEST RUNS -- SITE K

Run Number	mg/m ³	Vm (dscm)	Total mg
<u>Test Set Number 1^a</u>			
Run No. 1	5.8	5.237	30.3
Run No. 2	5.8	4.105	23.7
Run No. 3	5.6	4.365	24.4
<u>Test Set Number 2^b</u>			
Run No. 5	416	5.143	2139
Run No. 6	421	4.791	2016
Run No. 7	431	4.581	1977

^aTest set number one = background tests with 100% No. 6 oil in the heavy oil train.

^bTest set number two = hazardous waste tests with 70% No. 6 oil/30% waste solvent in the heavy oil train and spiked waste solvent in the light oil train.

TABLE 199. MATERIAL BALANCE CLOSURES FOR CHLORINE, HAZARDOUS WASTE RUNS --
SITE K

Test 2 Run Number	Cl-Equivalent in Feed ^a			Cl-Equivalent in Flue Gas (lb mole/hr)	Percent Closure ^b
	Heavy Oil (lb mole/hr)	Light Oil (lb mole/hr)	Total (lb mole/hr)		
Run No. 5	0.0406	1.3843	1.4249	0.7180	50.4
Run No. 6	0.0950	0.6034	0.6984	0.7384	105.7
Run No. 7	0.0956	0.6062	0.7018	0.7673	109.3

^aBased on ultimate analyses of feed samples.

^bPercent closure is defined as Cl-equivalent in flue gas divided by Cl-equivalent in feed.

TABLE 200. POHC DESTRUCTION EFFICIENCIES, PERCENT -- SITE K

Run Number	Carbon Tetra- chloride	Trichloro- ethylene	Chloro- benzene	Toluene	Benzene	m&p-Xylene	o-Xylene	Phenol
<u>Test Set Number 1^a</u>								
Run No. 1	b	b	b	99.980	b	99.9881	99.9873	b
Run No. 2	b	b	b	99.987	b	99.76486	99.78437	b
Run No. 3	b	b	b	99.989	b	99.55203	99.15868	b
<u>Test Set Number 2^c</u>								
Run No. 5	99.999	99.999	99.999	99.999	99.948	99.976	99.976	99.999
Run No. 6	99.998	99.999	99.999	99.999	99.994	99.915	99.949	99.999
Run No. 7	99.999	99.999	99.999	99.999	99.989	99.951	99.949	99.999

^aTest set number one = background tests with No. 6 oil in the heavy oil train.
^bNot detected in waste fee

^cTest set number two = hazardous waste tests with 70% No. 6 oil/30% waste solvent in the heavy oil train and spiked waste solvent in the light oil train.

TABLE 201. POHC EMISSIONS DATA DEVELOPED USING THE VOST SAMPLING TRAIN --
SITE K

Run Number	$\mu\text{g}/\text{m}^3$				
	Carbon Tetrachloride	Trichloroethylene	Chlorobenzene	Toluene	Benzene
<u>Test Set Number 1^a</u>					
Run No. 1	5.9	b	b	8.8	447
Run No. 2	2.3	b	b	5.2	215
Run No. 3	1.0	b	b	1.5	100
<u>Test Set Number 2^c</u>					
Run No. 5	3.8	2.3	0.2	3.1	43
Run No. 6	3.5	1.2	0.2	1.2	5.1
Run No. 7	1.6	1.1	0.3	3.1	11

^aTest set number one = background tests with No. 6 oil in the heavy oil train.

^bDid not exceed minimum detectable limit.

^cTest set number two = hazardous waste tests with 70% No. 6 oil/30% waste solvent in the heavy oil train and spiked waste solvent in the light oil train.

TABLE 202. POHC EMISSIONS DATA DEVELOPED USING THE MODIFIED METHOD 5
SAMPLING TRAIN -- SITE K

Run Number	Internal Standard ^a % Recovery	$\mu\text{g}/\text{m}^3$		
		m&p-Xylene	o-Xylene	Phenol
Test Set Number 1 ^b				
Run No. 1	85	15	2.4	c
Run No. 2	95	458	42	c
Run No. 3	87	607	57	c
Test Set Number 2 ^d				
Run No. 5	104	875	118	1.0
Run No. 6	62	2296	217	c
Run No. 7	116	1200	190	c

^aSpiked with D₈-Naphthalene.

^bTest set number one = background tests with No. 6 oil in the heavy oil train.

^cDid not exceed minimum detectable limit.

^dTest set number two = hazardous waste tests with 70% No. 6 oil/30% waste solvent in the heavy oil train and spiked waste solvent in the light oil train.

TABLE 203. ULTIMATE ELEMENTAL ANALYSIS OF THE HEAVY AND LIGHT FUEL OILS FIRED DURING THE TEST RUNS^a -- SITE K

Element	Test Set Number One			Test Set Number Two					
	Run No. 1	Run No. 2	Run No. 3	Run No. 5		Run No. 6		Run No. 7	
	No. 6 Oil	No. 6 Oil	No. 6 Oil	Heavy Oil	Light Oil	Heavy Oil	Light Oil	Heavy Oil ^b	Light Oil
Carbon (wt. %)	87.23	86.27	86.98	84.40	75.75	81.80	77.39	82.68 80.78	77.24
Hydrogen (wt. %)	10.92	10.47	10.72	11.35	10.88	11.20	11.40	11.04 11.20	10.59
Nitrogen (wt. %)	0.42	0.45	0.44	0.24	0.20	0.30	0.16	0.26 0.26	0.16
Chlorine (wt. %)	0.08	0.11	0.11	0.09	2.88	0.21	1.28	0.25 0.14	1.21
Sulfur (wt. %)	0.56	0.79	0.70	0.48	0.05	0.46	0.04	0.40 0.42	0.10
Ash (wt. %)	0.06	0.05	0.05	0.07	0.06	0.07	0.05	0.10 0.09	0.07
Oxygen ^c (wt. %)	0.73	1.86	0.92	3.37	10.18	5.96	9.68	5.27 7.11	10.63

^aAnalysis performed on composite fuel oil samples made from individual heavy and light fuel oil samples taken every 30 minutes during the test runs.

^bDuplicate analyses were obtained for the composite heavy oil sample from run number 7.

^cWeight percent oxygen obtained by difference.

TABLE 204. HEATING VALUES, DENSITIES AND WATER CONTENTS OF THE HEAVY AND LIGHT FUEL OILS FIRED DURING THE TEST RUNS^a -- SITE K

Measured Parameter	Test Set Number One			Test Set Number Two					
	Run No. 1	Run No. 2	Run No. 3	Run No. 5		Run No. 6		Run No. 7	
	No. 6 Oil	No. 6 Oil	No. 6 Oil	Heavy Oil	Light Oil	Heavy Oil	Light Oil	Heavy Oil ^b	Light Oil
<u>Heating values</u>									
Btu/lb	18,504	18,416	18,449	18,818	16,834	18,159	17,519	18,200 18,270	16,951
Btu/gal @ 60°F	148,532	148,636	157,647	142,509	122,585	137,682	124,632	138,083 138,834	125,387
<u>Gravity</u>									
Specific @ 60/60°F	0.9639	0.9692	1.0262	0.9094	0.8745	0.9106	0.8576	0.9111 0.9123	0.8883
lbs/gal @ 60°F	8.027	8.071	8.545	7.573	7.282	7.582	7.141	7.587 7.599	7.397
°API @ 60°F	15.3	14.5	6.4	24.1	30.3	23.9	33.5	23.8 23.6	27.8
<u>Water content^c</u>									
% by volume	0.00	0.08	0.00	0.40	0.80	1.40	1.20	1.60 1.40	1.40

^aAnalysis performed on composite fuel oil samples made from individual heavy and light fuel oil samples during the test runs.

^bDuplicate analyses were obtained for the composite heavy oil sample from run number 7.

^cWater content as measured by distillation.

TABLE 205. GC/MS FEED ANALYSES -- SITE K

Run Number	Weight Percent in Feed Samples							
	Carbon Tetrachloride	Trichloro- ethylene	Chloro- benzene	Toluene	Benzene	mMp-Xylene	o-Xylene	Phenol
Test Set Number 1^a								
Heavy Oil Feed								
Run No. 1	b	b	b	0.07	b	0.2	0.03	b
Run No. 2	b	b	b	0.06	b	0.3	0.03	b
Run No. 3	b	b	b	0.02	b	0.2	0.01	b
Test Set Number 2^c								
Heavy Oil Feed								
Run No. 5	b	b	b	2.2	0.1	4.8	0.5	b
Run No. 6	b	b	b	3.5	0.2	5.1	0.9	b
Run No. 7	b	b	b	2.6	0.2	3.8	0.6	b
Light Oil Feed								
Run No. 5	1.1	0.8	0.9	1.3	0.1	4.3	0.7	24
Run No. 6	1.0	0.9	0.9	1.3	0.1	4.3	0.6	20
Run No. 7	0.8	0.8	0.9	1.0	0.1	3.4	0.5	25

^aTest set number one = background tests with 100% No. 6 oil in the heavy oil train.^bDid not exceed minimum detectable limits.^cTest set number two = hazardous waste tests with 70% No. 6 oil/30% waste solvent in the heavy oil train and spiked waste solvent in the light oil train.

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